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THE HEATING AND VENTILATING MAGAZINE

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The Transmission of Air and Its Movement in Ducts

THE DEVELOPMENT OF A NEW SCHEME FOR PROPORTIONING AIR DUCTS AND OUTLETS

BY GEO. W. KNIGHT AND PERRY WEST

If a ball be started rolling upon a smooth, level plane, it will continue to roll, constantly reducing in speed, until it finally comes to rest. The kinetic energy of the ball at any point throughout its path will be exactly equal to its kinetic energy at the start, less the energy expended in friction up to this particular point. In other words, if the expression may be applied, the velocity head of the ball at any point will equal its velocity head at the start, minus the friction head up to this point.

In like manner, if a section of the air moving in a straight uniform sized duct could be suddenly isolated from the remaining air in this duct, and left to move, without the action of any exterior force, it would move in a manner similar to that of the ball described above. The velocity head at each point of its movement would be equal to the velocity head which it had at the point of isolation, minus the friction head between this point and the other point under consideration. The section of air would continue to move, constantly reducing in velocity, until it came to rest at a point where the friction head exactly equalled the original velocity head; and the sum of the friction and velocity heads would be the same at every point throughout the path of travel, and would equal the original velocity head.

In the case of the ball, if it is desired to keep the speed of travel constant, a constant exterior force, equal to the friction head, must be applied to the ball throughout its travel; and likewise with the isolated section of air. In the case of air this exterior force would be termed a static pressure or head, and would be constant for an infinitesimally short section of the air only. In the case of a length of duct, through

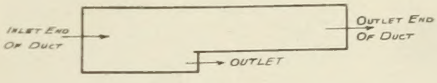


FIG. 1

which air is transmitted at a constant velocity, and discharged at atmospheric pressure, the static head at the entering end would equal the total friction head of the duct, while the static head at any other point throughout the duct would be less, but would always equal the friction head between the point in question

and the outlet end of the duct; becoming zero at the outlet end.

Therefore, the static pressure in a uniform sized duct, through which air is transmitted at a uniform velocity, builds up from the outlet end towards the inlet, and the total pressure at any point is equal to the velocity head, plus the static head. If an outlet (Fig. 1), be provided in such a duct and the duct area between this outlet and the outlet end of the duct be decreased, an amount depending upon the quantity of air taken out, the velocity within the duct will remain constant, but the velocity through the outlet will be greater than the velocity in the duct, since the velocity head at the outlet must equal the sum of the velocity and static heads within the duct.

Again, if a duct be attached to this outlet and continued (of equal size)

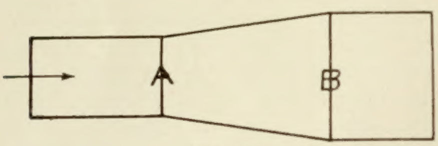


FIG. 2

for any length, the velocity through the duct will be less than it was through the outlet before the duct was added, since, in this case, the velocity head plus the friction head in the added duct must equal the same sum (of the velocity and friction heads in the main duct) as was formerly equalled by the velocity head alone, at the outlet.

Also, since the introduction of a Pitot tube into the air current of a duct produces in the tube a static pressure equivalent to the velocity head in the duct, the bringing of air in motion to rest must produce a static pressure equivalent to its velocity head.

Carrying this a little further, if, instead of having the outside end of the small tube of the Pitot instrument blanked off, a small pet cock be provided so as to vary the velocity through this tube to the outside air, we would get static pressures within the tube equal to the velocity head in the duct, minus the velocity head in the tube. Or in other words, if the velocity of air in motion be decreased, without eddies or friction, a static head is produced exactly equivalent to the difference in the velocity heads.

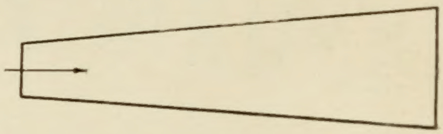


FIG. 3

In a duct, therefore, such as shown in Fig. 2, the decrease of velocity between the points (A) and (B) produces a static head equal to the difference in the velocity heads at (A) and (B), minus the friction and eddy losses between these two points.

This action has been tested in practice, and found to agree with theory; and when the slopes of the increaser are gradual, the losses from friction and eddies are found to be negligible. A duct constructed with a gradual taper, therefore, (Fig. 3), and increasing in such a way as to make the friction head at any point equal to the difference between the velocity head at this point and the velocity head at the end of the duct from which the friction head is figured, will be entirely free from static pressure due to fric-

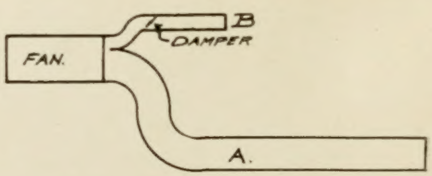
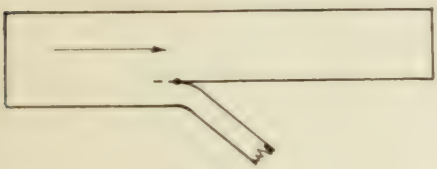


FIG. 4

tion. This is evident from the fact that the rate of loss in velocity head is everywhere just equal to the rate of friction head being added, and the two balance one another.

With these few fundamental principles before us, we will pass to the subject of the practical movement of air in ducts. The problem is to dis-

tribute the required quantity of air at the minimum cost, consistent with conditions. One of the principal items of cost is for power to handle the air. Neglecting everything else, outside of the distribution system, about all that remains are the overhead charges on the cost of this system and the value of the space which it occupies. Regarding the space occupied there are so many conditions such as the character of building,



disposition of ducts, etc., that same will be neglected here, except to say that usually ducts may be run where the value of the space for other purposes is of no consequence. The power required for forcing the air through the duct system is almost exactly proportioned to the total head in the ducts and this head is generally equal to the total head in the longest duct.

Inasmuch as this head or pressure must be maintained at the fan outlet, all other ducts starting from this same point should have the same total head (velocity plus static) at their starting point. The logic of this may be seen by reference to Fig. 4, showing two ducts (A) and (B), connected to the same fan outlet. Assuming that (A) is the longer of the two ducts, and that it consequently has a higher friction head, duct (B) should be designed for a velocity such that the sum of its velocity and friction heads will equal the sum of the velocity and friction heads in duct (A). If duct (B) be made larger on the assumption that it should transmit air at the same velocity as duct (A) does, it would not do so without the use of a damper, since the total head delivered by the fan is the same for both ducts, and if the total head in duct (B) is less than in duct (A), then the velocity in (B) will automatically increase up to a point where these total heads are equal. The introduction of a damper, therefore, for creating a friction head instead of decreasing the duct size, evidently results in a waste of duct material and space.

Again, if a branch duct is taken off a main duct (such as shown in Fig. 5), the design should be such that the total head for each duct will be the same at the junction point, and for the same reasons as cited above.

By this procedure the main distribution ducts may be designed on the most economical basis, provided the total head at the fan is properly selected to start with, so as to give the proper velocity through the duct having the highest total head at the fan.

This critical velocity may be determined as follows: Find the horsepower required to handle the total quantity of air at the total head selected and determine the cost of this per year. Compare this with the overhead charges on the distribution system and adjust the two to a point where their sum is a minimum.

Taking a recent building as an example, the galvanized iron ducts were designed for maximum velocity of 1,500 ft. per minute. This is equivalent to 0.08 oz. pressure per square inch head at the fan.

The total quantity of air handled is 36,000 cu. ft. per minute and the cost of the main duct system, exclusive of short connections to outlets, is $1,500. The yearly cost of power for forcing the air through these ducts at $0.05 per k. w. hour, for six hours per day, twenty days per month and eight months per year, figuring the total efficiency of the fan unit at 50 per cent., is $75.00. The overhead charges on the duct system at 10 per cent. is $150.00.

Assuming that the cost of ducts would be inversely proportional to the velocity, and that the cost of power would be directly proportional to the square of the velocity, it

will be seen that the above system operates at about a minimum cost for this particular building.

It may be noted here that no static pressure in figuring this power is allowed for, as the duct system in question is designed so as to eliminate static pressures, as will be explained later. It is not necessary to figure out this critical velocity for each and every building for which a duct system is to be designed, as the same velocity may be safely used for each class of building with certain modifications covering different sizes and peculiarities of layouts.

In figuring the friction head in ducts the following formula may be used:

$H=KLV^2R$, when (H) = the friction head in ounces per square inch, (K) equals a constant, depending upon the condition of the duct surface; (L) = the length of duct in feet; (V) = the velocity of air in thousands of feet per minute, and (R) = the ratio between the perimeter of the duct in inches and its cross sectional area in square inches. For smooth galvanized iron ducts (K) may be taken as 0.0028.

Thus for a galvanized iron duct 12 in. x 12 in. 50 ft. long, transmitting air at a velocity of 2,000 ft. per minute the friction head (H) = $0.0028 \times 50 \times (2)^2 \times 0.333 = 0.1866$ oz. per square inch. The friction around turns and elbows must be added to that for the straight length and may be figured from the above formula by allowing for (L) a value equal to a certain number of diameters for round pipes and to a certain number of widths for rectangular pipes. The following table gives the equivalent straight pipe for 90° ells, in diameters, for different radii of ells.

A	B
0.5	29.0
1.0	10.3
1.5	6.0
2.0	4.4
2.5	4.6
3.0	4.8

A = Ratio of inside radius of elbow to diameter of pipe.

B = Equivalent number of diameters of straight pipe.

After the main ducts of a system are disposed of, the question arises as to how the air can best be delivered from these ducts through the various outlets. The prime considerations in bringing fresh air into any space are thorough distribution and proper velocity. It is evidently impossible to properly distribute air throughout all portions of a room unless a uniform velocity is secured over the entire area of the inlet openings.

The velocity at which air should enter any space depends entirely upon the location of the registers (height from floors, etc.), dimensions of space and the use for which this space is intended, but at the same time air should never enter any space so as to create objectionable draughts. The maximum velocities allowable so as to entirely eliminate drafts have been pretty well determined.

An opening having an uneven velocity of discharge is objectionable for the reason that, if the highest velocity is below the allowable maxi-

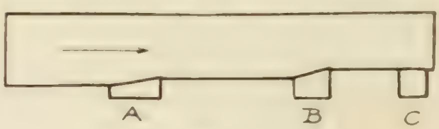


FIG. 6

mum, the total discharge is below what an opening of this size should give, and the opening is unnecessarily large; if the highest velocity is increased so as to give the opening its proper discharge, this velocity is above the allowable. The design of the main duct system, as well as that of the connections between these main ducts and the various delivery openings, has much to do with this matter of the proper distribution of air through the openings.

Taken in all of its phases, the question of properly transmitting and distributing the air from the main ducts through the openings, is perhaps one of the most important

connected with the design of duct systems.

Take a duct, for instance, which is designed for a uniform velocity of air throughout its length (with all openings open) and having the three openings (A), (B) and (C) (Fig. 6).

The velocity head in the main duct will have little or no influence upon the velocity of discharge through these openings. Whatever the discharge velocity, it will be almost wholly due to static head, and will vary for the three openings, being greatest at (A) and practically zero at (C).

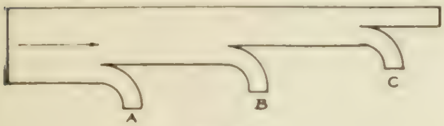


FIG. 7

Take another duct designed as before, for a uniform velocity of air throughout its length (with all outlets open) and having three outlets (A), (B) and (C), but with the outlets arranged as in Fig. 7.

Here the velocities through (A), (B) and (C) will depend upon the velocity in the main duct as well as upon static pressures, the greatest velocity will be through (A), as before, but the velocity at (C) will not be zero and the difference between outlet velocities will not be so marked. This variation in velocities will depend upon the ratio between velocity head and friction heads in the main duct. If the distance between openings is great and the main duct small, the friction will be great, and consequently the static head at (A) high; and the higher this static head the greater its influence towards unequal outlet velocities.

If with either of the two above ducts a section of the outlet end of the main duct be blanked off, and the remaining outlets adjusted so as to maintain an even velocity throughout the main duct, an additional and constant static pressure will be created along the entire duct, which will act upon each outlet similarly to the action of the frictional static head just mentioned, except that one is constant, and the other varies for the various outlets.

It is readily seen that it is a very difficult matter to properly design outlets from this type of duct, and to tell beforehand what the velocities of discharge will be. It is true in the case of Fig. 7, that the area of outlets may be proportioned for the same velocity through the outlet as is maintained in the duct, but the velocities through (A) and (B) will be greater than required and must be cut down by a damper, causing higher velocities than would otherwise be gotten through the proper sized opening.

Again, in a main duct designed for uniform velocity, if a short connection be taken off to a large opening, as shown in Fig. 8, the velocity head tends to create a flow of air out through the opening as shown by the curved arrows, while the static head tends to create a flow as indicated by the straight arrows. The result is that there is no way of estimating what the distribution will be through such an opening for the varying combinations of velocity and static heads met with in practice.

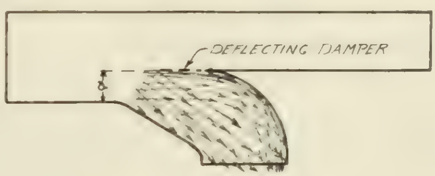


FIG. 8

The determination of the dimension (a) (Fig. 8) is also impractical and results in deflectors set at all kinds of sharp angles. The authors of this paper, after coming to a full realization of these many difficulties surrounding the proper distribution of air from ducts designed on the uniform velocity principle, have developed a system for designing ducts without static heads.

DUCT SYSTEMS WITHOUT STATIC HEADS

The principle discussed in connec-

tion with Fig. 3 was made use of; the idea being to begin at the first outlet in each duct and decrease the velocity continually, to the end of the duct, in such a way as to allow the friction head at all points to be offset by the static head due to loss in velocity head. This gives a duct such as shown in Fig. 9.

Here the dimensions (a) and (b) may be more readily and correctly determined, by simply allowing for a velocity through the area of opening at these points equal to the corresponding velocities in the duct; which greatly simplifies the design. Long ducts designed on this principle are smaller at the beginning or large end and larger at the terminating or small end than constant velocity ducts designed for the same service and having the same total head would be.

For this reason some very objectionably large main ducts are reduced near the fan, or starting point, and the smaller ones which create friction fastest out near the end are enlarged. The system as a whole, being thus equalized and being more uniform, is easier to build and accommodate. The elimination of static heads, while it greatly facilitates in the correct designing of the outlet, does not otherwise assist in the production of a uniform velocity through the same.

The velocity through opening (A) (Fig. 9), may be expected to vary as shown by the arrow diagram. This condition may be materially improved by the introduction of diffusing plates such as shown at outlet (B), where the discharge velocities will be about as shown by its arrow diagrams.

If, in such a duct, the outlets be arranged as at (C), with an adjustable extension deflector and these deflectors be set, as shown, so as to lessen the velocity effect, a static pressure will be created in the duct, and act as indicated by arrows. By the proper adjustment of this deflector, a fair distribution should result. The static head necessary will

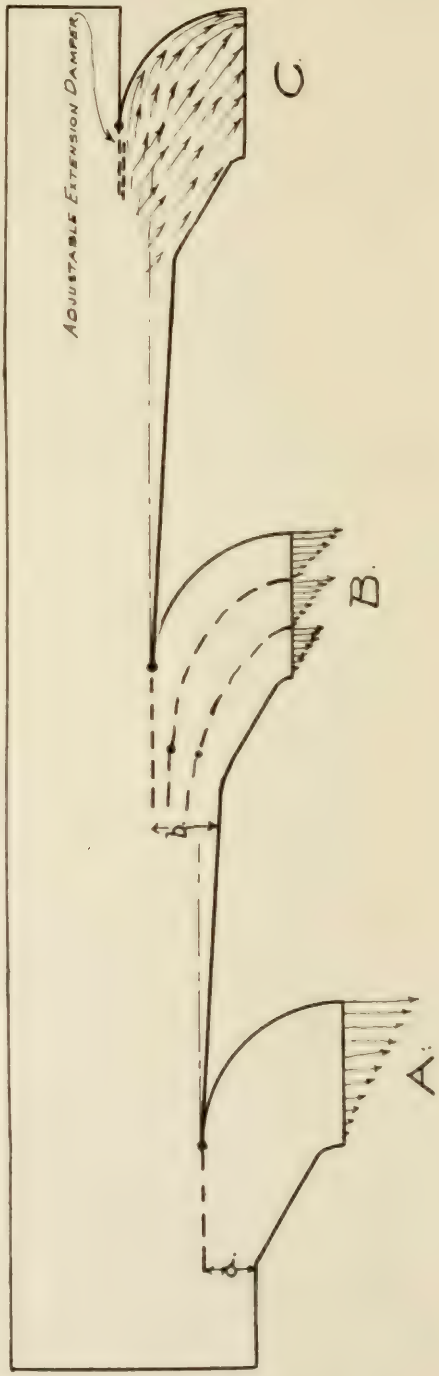


FIG. 9

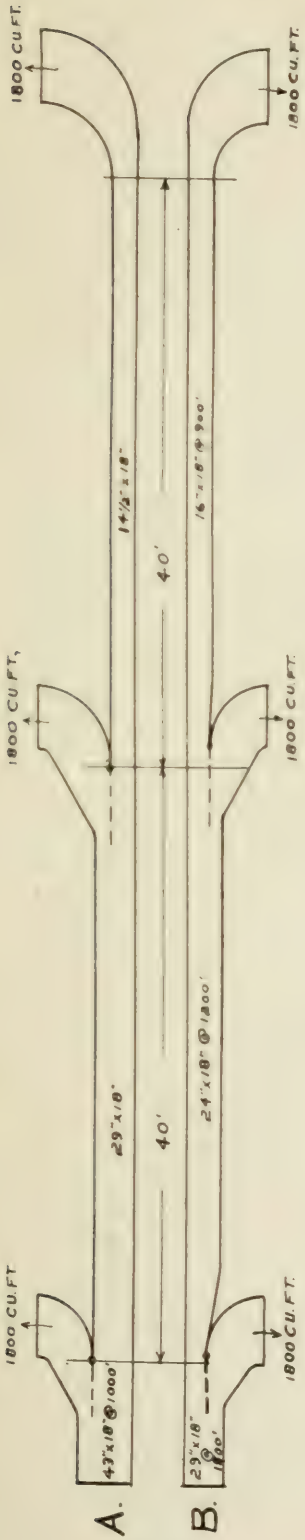


FIG. 10

be additional to the velocity head, and will require additional work to be done by the fan. This design is wasteful of power, therefore, since the same velocity head must be maintained, and, in addition, a static head.

Fig. 10 shows a comparison of two ducts designed for the same purpose and to operate under the same total head. Duct (A) is designed on the constant velocity principle, and duct (B) is designed on the reducing velocity principle, to eliminate static pressure.

It will be seen that there is less material in duct (B) than in duct (A), notwithstanding the increasing sizes toward the end.

The question now naturally presents itself, how to maintain a high velocity in the main ducts, and at

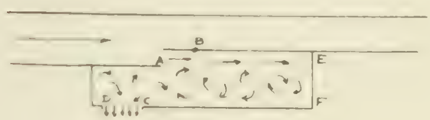


FIG. 11

the same time secure a low even velocity at the registers. Obviously, it is first necessary to do away with a portion of the velocity head, leaving just enough to give the air the proper velocity at the register, but while accomplishing this, we should not lose sight of the fact that it is imperative that the velocity at the register be uniform over the entire area.

In order to lose a portion of the velocity head, it is necessary only to place some obstruction, such as a damper, in the path of the air, but to secure an absolutely uniform velocity over the entire register area, is a more serious problem. In order to accomplish this double purpose, viz., a reduction of velocity head, with uniform velocity at register, a duct was made with a large box attached to it, the register opening being behind the point where the air enters the box at a high velocity. (Fig. 11.)

The object of the large box was to allow the air to swirl around as indicated by the arrows, losing a portion of its velocity head and then find its way out at the register opening. The end (EF) was so arranged that it could be moved up toward (B), the assumption being that

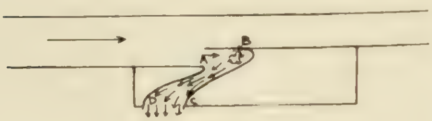


FIG. 12

this end would be moved backward and forward (varying the friction head), until the proper velocity at the register opening was secured. Under low velocities, the operation was perfect, but with a velocity of 1,000 ft. per minute in the main duct, the experiment was only partially successful, in that the velocities at the register opening were extremely variable.

A great many tests at different velocities were made with this form of duct, but the results for like conditions, with respect to a uniform velocity at the register opening, varied to such a degree that it was evident that the air, after leaving the opening (AB), should be conducted through a passage of particular shape to the opening (DC), in order to secure a uniform velocity at (DC). In order to arrive at the proper shaped passage, the points (BC) and (AD) were connected with thin sheet iron, and the shape of these two sheets of iron was continually changed, until a uniform velocity was secured.

The form shown in Fig. 12 was one that finally evolved, and which gave perfect results, and after having conducted a great many tests on this form of connection, during which tests the travel of the air in the connection was carefully noted, the dimensions of the connection were computed, and put on a scientific basis, as shown by Fig. 12.

Economy in the Ventilation of a Hospital Building

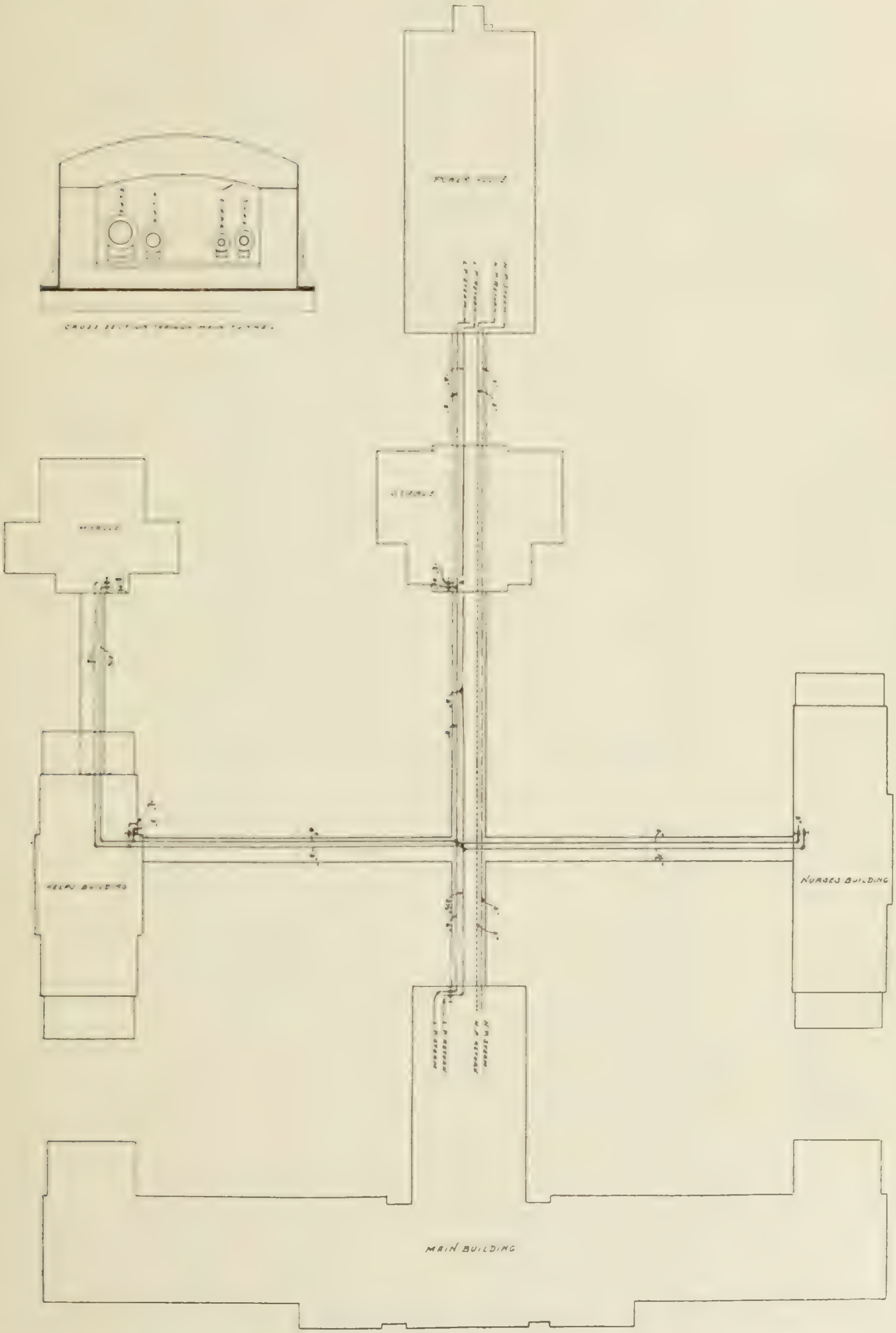
FEATURES OF THE MECHANICAL EQUIPMENT OF THE CONEY ISLAND HOSPITAL, BROOKLYN, N. Y.

The accompanying plans illustrate an interesting solution of a heating and ventilating problem in which it was necessary to cut the cloth to fit the pocketbook, or, in other words, to bring the cost of installation within the limits of the appropriation, at the same time securing the desired results.

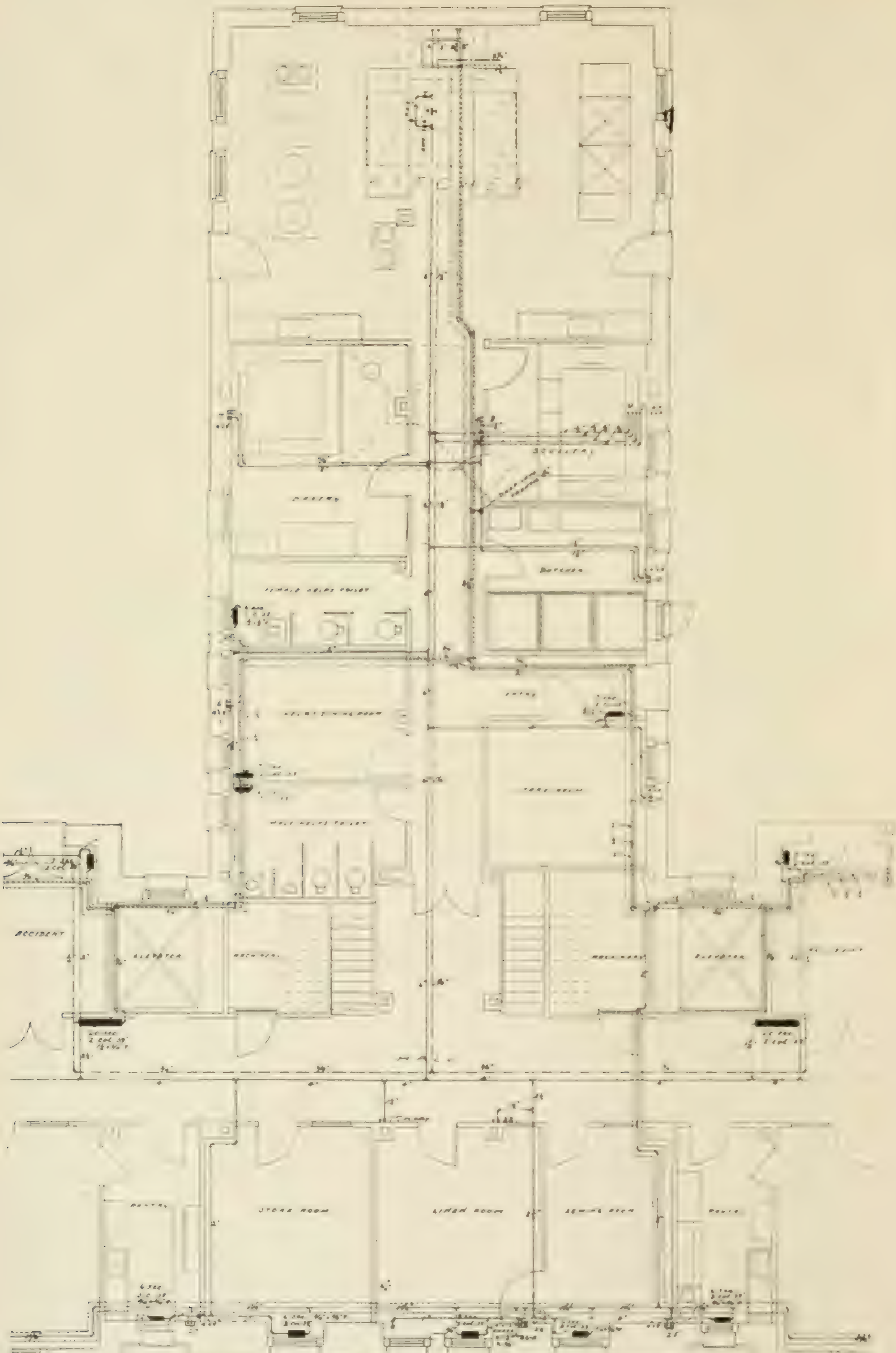
The original scheme for heating and ventilating the Coney Island Hospital provided for mechanical ventilation, with fans and ducts. The accompanying plans show the alternative scheme decided upon to reduce the first cost.

The main hospital building it will be noticed is, for the most part, heated and ventilated by means of indirect radiation, the air being extracted near the floors of the rooms and thence through ducts and flues to the roof by means of aspirating coils.

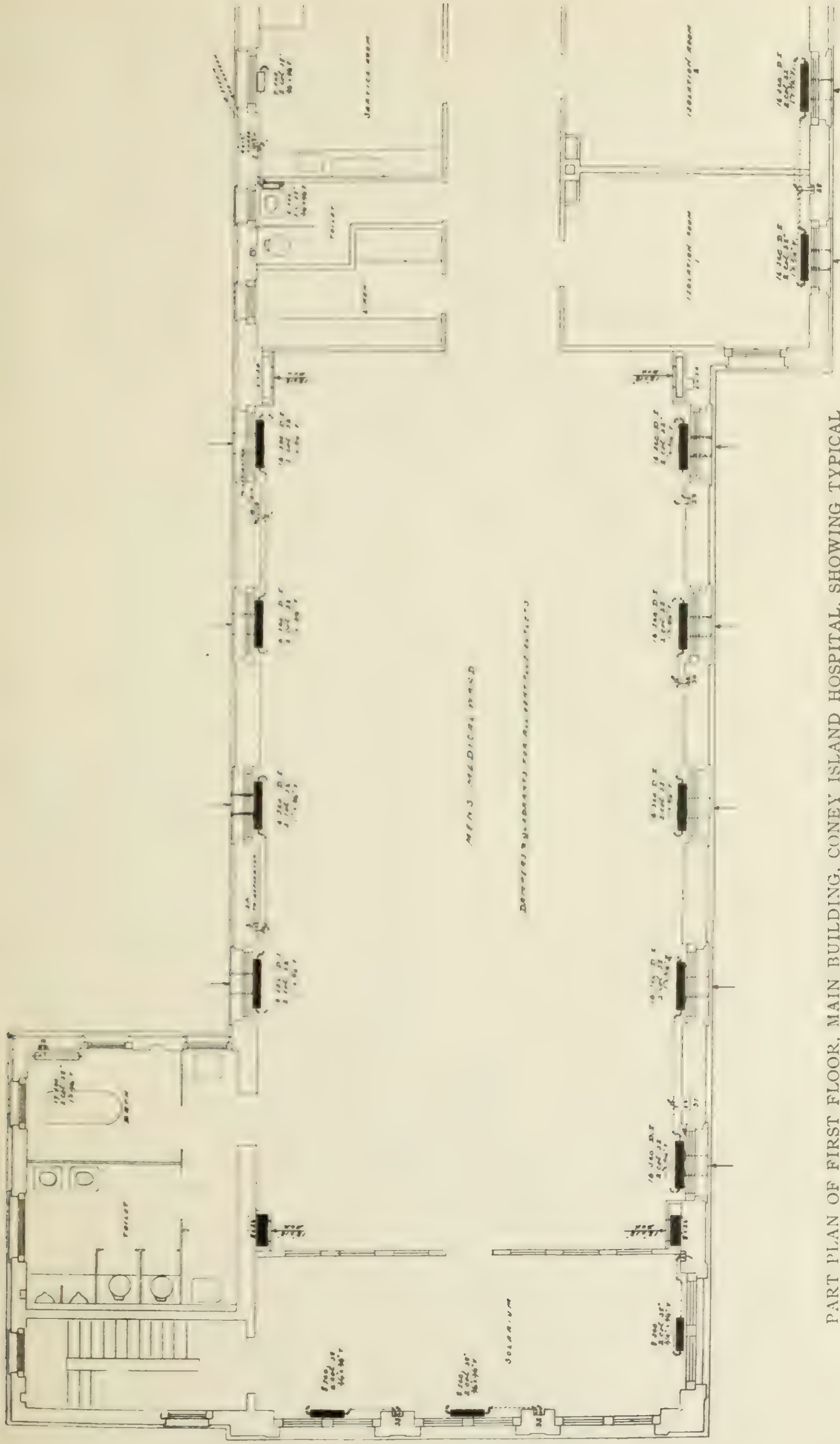
There are six buildings in the group including the main hospital building, nurses' building, helps' building, stable, morgue and the power and laundry building. Concrete pipe ducts connect the various buildings with the power house as shown on the block plan. These ducts are composed entirely of concrete, with concrete manholes. In the main hospital building the return pipes are carried along the ground floor in concrete pipe trenches 12 in. wide and 12 in. deep. These trenches completely encircle the building and are run close to the exterior



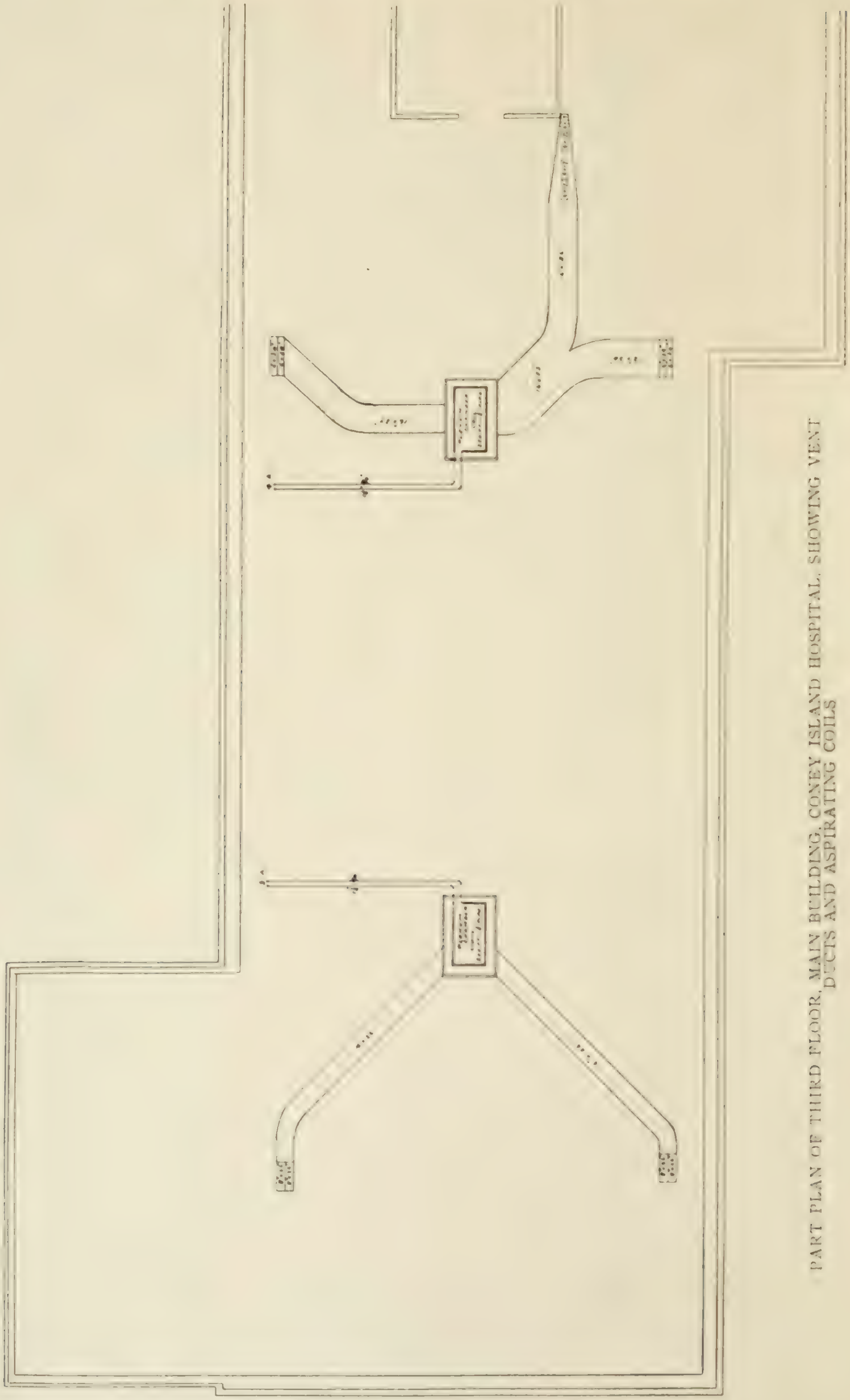
BLOCK PLAN OF CONEY ISLAND HOSPITAL, SHOWING STEAM PIPE LINES AND SECTION OF MAIN TUNNEL



GROUND FLOOR PLAN, MAIN BUILDING, CONEY ISLAND HOSPITAL, SHOWING TRENCHES FOR RETURN MAINS



PART PLAN OF FIRST FLOOR, MAIN BUILDING, CONEY ISLAND HOSPITAL, SHOWING TYPICAL INDIRECT HEATING SYSTEM

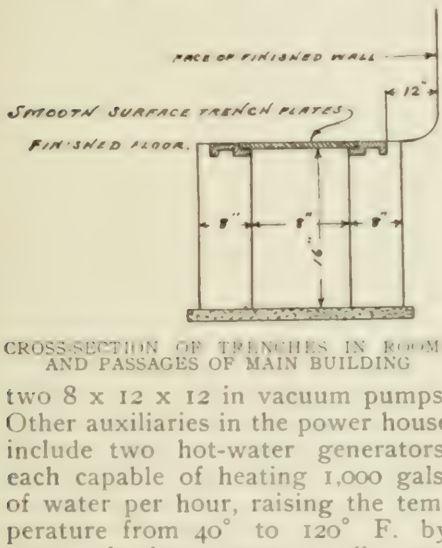


PART PLAN OF THIRD FLOOR, MAIN BUILDING, CONEY ISLAND HOSPITAL, SHOWING VENT DUCTS AND ASPIRATING COILS

walls. They are provided with iron trench covers. Most of the flooring on the ground floor is of cement.

The power plant is designed not only to heat and ventilate the buildings, but also has high pressure connections to the kitchen fixtures, serving tables and sterilizers in the main building. The heating is accomplished by a two-pipe vacuum steam system.

For these purposes two horizontal tubular boilers are used, each 72 in. in diameter and 16 ft. long. High pressure lines are run to two 7½ x 5 x 8 in. duplex steam pumps and



CROSS-SECTION OF TRENCHES IN ROOMS AND PASSAGES OF MAIN BUILDING

two 8 x 12 x 12 in vacuum pumps. Other auxiliaries in the power house include two hot-water generators, each capable of heating 1,000 gals. of water per hour, raising the temperature from 40° to 120° F. by means of exhaust steam at 1 lb. pressure and one 500 H. P. open feed water heater.

The main steam pipe starts at the duct entrance of pit in the power house, after first receiving the exhaust supply through a gate valve and reduced pressure steam through a reducing valve. The heating and high pressure mains travel through the duct to the main building, with outlets for the heating mains to the other buildings. The pipes enter the main building through a vertical duct rising to the ceiling whence the heating main continues around the ceiling of the main building. The return mains and branches in the main building are carried, as stated, in concrete trenches, and thence through the concrete tunnel, terminating at the vacuum pumps in the power house.

Special temperatures are required in many of the rooms, varying from 90° in the operating room to 65° in the toilets.

The vitiated air is removed from the rooms through a system of vertical and horizontal iron vent ducts, the air being drawn from the rooms to plenum chambers in the attic. Here the ventilation is assisted by aspirating coils, as shown. The steam supplies for these coils are taken separately from the high-pressure pipes in the basement. Each coil contains 100 sq. ft. of heating surface and is made of 1¼ in. pipe, supported on brackets. The horizontal vents are collected separately into these plenum boxes, one of which is located over each of the north and south wings and one over the center section of the building. The tops of the plenum or ventilating chambers have each a 36 x 48 in. automatic ventilator.

The terminating openings of each vent in the rooms which they are drawing from is near the floor in each case and have cast-iron white enamel vent registers.

The power plant and heating and ventilating work was designed and installed by Blake & Williams, New York. The architects for the hospital are Helmle & Huberty, Brooklyn, N. Y.

The ever-pressing question of proper ventilation in the rooms of the Chicago public schools, one that has given rise to discussions and experiments in "open-air" rooms, increased humidity and the employment of numerous other devices, has taken on a new angle in the form of an introduction of ozone as a possible stimulant to produce good air.

The possible merits of ozone have been discussed by the members of the school management committee of the board of education. It has decided to permit the installation of ozonizers in several schoolrooms for the purpose of experiment.

What Is the Matter with Modern Heating Practice?

THE ANSWER OF AN EXPERT TO THE AGITATION AGAINST PRESENT METHODS

By Konrad Meier

There is a widespread feeling that the modern ways of heating, though more efficient, are not as healthy as the open fire-place, the Dutch tile oven, or even the ordinary stove. Evidently, there must be some basis for this contention. We need only remember that the close, lifeless air and stuffiness too often met in buildings heated by boiler or furnace cannot always be traced to crowded occupation. Nor can it be the failure to use the windows, inasmuch as the desire to open them is rather induced, sometimes almost compelled, by these conditions. Another significant fact is that the demand for ventilation has only arisen since hot-air registers and radiators have become general. No further evidence is necessary for the general conclusion that present day methods of heating in some way spoil the air, but it is worth while to look further into cause and effect in order to find the right means of prevention.

THE VITIATION OF AIR BY HEATING

At first thought there seems to be no reason why a steam heating apparatus, or a hot-air furnace in good condition, should alter the quality of the room air, aside from an unavoidable drying effect, not necessarily objectionable in itself. Nevertheless, on closer investigation some distinct causes of vitiation, not recordable by the ordinary methods of air testing, have been shown to exist, and found to create unwholesome conditions. We are indebted especially to two noted German hygienists, von Esmarch and Fluegge, for their investigations on this elusive subject. They have established that the stuffiness of air in heated rooms is caused by the decomposition of dust in contact with radiating surfaces at temperatures of 160° F. and higher.

This process is not one of full combustion, generating carbonic acid, but a sort of dry distillation or singeing of the organic matter, which produces small quantities of the highly injurious ammonia, also traces of carbon monoxide and other gases. The presence of the former gas is explained by the quantities of animal excreta, one of the principal ingredients of ordinary street-to-house dust. It shows the little appreciated fact that dust, while comparatively harmless on furniture, will become objectionable when allowed to settle and decompose on radiators.

The gases thus generated are most noticeable after a period of interrupted heating. Under continuous service the quantities are generally too small for detection. But, in addition to this variable pollution, a constant irritation of the mucous membrane of nose and throat is kept up through the simple drying of the dust on heating surfaces, which lightens it and causes it to be picked up freely by the warm air currents. Even the dust on adjacent objects, also in ducts and air chambers, is dried and joins the procession of irritant, disease-bearing particles induced by the common forms of modern heating.

The meaning of this is plain when we remember, that the dry heat is not sufficient to kill the bacteria carried by the dust, and that we inhale them in much greater numbers owing to the currents of air created by heaters, more especially those with unsanitary surfaces. It is also the presence of fine dried dust which is often responsible for complaints from dryness. The real cause is not dryness of air, but dried dust. Pure dry air has never been shown to be harmful. It has also been established that whatever little ozone may enter a room with the outer air is quickly used up in contact with

organic dust, especially when heated. A small percentage of oxygen is absorbed in the same manner, but the extent and exact bearing of this fact has not yet been determined. These last points alone would account for the lifeless quality of the air as it generally issues from a register.

When these factors are considered, it will be admitted that an open grate, carrying its own vitiation up the flue, or a tile oven with clean, moderately warm surfaces, or even an iron stove kept polished, could not vitiate the room air to the same extent as will a radiator with inaccessible dusty surfaces, or a register blowing hot air from a musty source beyond inspection.

All this is not meant to advocate a return to the old-fashioned ways of heating, but only to show that the newer methods are actually at fault, and should be improved along lines suggested by the recent findings of hygienists. The result eventually will be a merging of the good features of past and present methods.

SANITARY HEATING

When planning apparatus, the first point in hygiene to be borne in mind should be to reduce contamination through dust by using the cleanest possible radiation. This means that heating surfaces should be in plain view, and accessible all around by hand, so that they will be kept clean, not by special effort, but as a matter of course in the ordinary routine of a household. Dust on concealed radiation, even if made accessible, is not seen, and, therefore, is invariably forgotten and neglected.

These facts should be sufficient, quite aside from engineering and economic reasons, to condemn all radiator screens designed for purposes of meaningless decoration. They are not the true solution of the problem and really turn direct radiation into a hot-air system without air supply. Screening is a sham, and should be vigorously opposed, not mildly tolerated. We should rather encourage neat, substantial appearance, inconspicuous finish and simplicity in arrangement of radiation. Unsightly bulk can often be reduced by judicious disposition and selection of the most advantageous style, or by deliberate reduction of the heat requirement, such as using double glass.

When direct radiation is indicated, it is possible, even in highly ornamental and formal rooms, to satisfy the artistic sense of architects without resorting to concealment. It is mainly a matter of judgment as to style and neatness in disposition, also of having the courage of one's conviction in arguing with the client. Of course, the public must yet be educated on the sanitary points, and the engineer on the ways and means to meet the situation. The present disinclination to expose radiators is mainly due to the shabby, clumsy and tasteless treatment that now prevails.

Radiating surfaces placed overhead or tight against walls are also objectionable. They are never dusted, except by an occasional air current, and then with a decided effect on the air. Fussy, round-about pipe connections behind radiators, creating dirt corners never cleaned out, are too often seen even in the better class of buildings. They always contribute to stuffiness, as do many styles of heating surface which are designed too much with a view to saving space and give too little chance for keeping them clean.

As will be pointed out later, indirect heat should be used only with certain restrictions. The casings enclosing the stacks should never be soldered up, or provided with a hand hole only. At least one full side should be hinged or made removable to invite occasional inspection and cleaning. Air filters should be used in cities to keep out the dust as much as possible. In general, dust pockets and dirt corners must be avoided. They are objectionable anywhere, as a latent menace to health, but become at once an active agent for mischief in connection with heat, which brings out the lurking germs and distributes them where they are most likely to do harm.

TEMPERATURES OF HEATING SURFACES SHOULD BE LOWERED

The second point of importance is the lowering of the temperature of heating surfaces, both with a view to preventing dry distillation, and for reducing the intensity of air currents. Hot-water heating gives the simplest and most effective means to this end. With the piping calculated and balanced accurately to secure even circulation at any flow temperature, it gives practically a full range of general control and makes it possible to carry heat strictly to suit the weather.

This means that for the greater portion of the heating season the temperature of heating surfaces need not reach the point at which decomposition is beginning to be felt. In hospitals, schools, and in other cases the surfaces might be increased within reasonable cost to keep the highest flow temperatures down to 160° F. or 170° F., so that a slight formation of gas could only occur under extreme conditions.

With hot-water heat applied by clean, well distributed radiation it is, therefore, quite feasible to eliminate practically all vitiation of room air through dust.

This is the reason for the popular feeling that this form of heat does not dry the air as much as steam. With the latter it becomes all the more important to insist on the cleanest form of surfaces, and to reduce the working pressure or temperature as much as possible. At best, steam heat will always be less desirable from the hygienic point of view. Hot air furnaces, to be tolerable at all, should be installed of very ample sizes, giving the desired heating effect without excessively hot surfaces.

When heating by warm air, whether furnace or indirect stacks, the registers should always be in vertical position, never horizontal. Floor registers, especially, are dirt catchers in the most aggravating form, throwing up the dried dust and microbes straight into one's nose.

OVERHEATING

According to Fluegge, the proper attention to room temperature is hardly second in importance to the benefits of ventilation as generally accepted. He has demonstrated, that overheating is just as injurious, if not more so, than the effect of ordinary foulness of air due to lack of renewal. He explains this through heat congestion, caused by decreased emission from the human body, with a consequent disturbance of certain functions. It may be held, at first thought, that summer heat would be equally, if not more injurious, but the conditions are distinctly different. Lighter clothing and freer air circulation usually allow of much greater heat emission by evaporation, except in the hottest and sultriest weather which is known to be a tax on vitality even for short periods. In crowded, overheated, though ventilated rooms, with the occupants close together, keeping each other warm by their own radiation, and wearing heavier clothing, the heat emission from the human body is very much reduced.

It is naturally difficult to determine the relative bearing of foulness and of overheating, each depending so much on the degree and also on humidity, but the fact remains that overheating has been shown to be injurious in itself and is apt to be more so when combined with foul air, humidity and with pollution through unsanitary heating apparatus. Equable, moderate temperature is, therefore, one of the primary hygienic requirements.

The logical way of meeting it is effective heat control, not only to suit the weather, but to take care of the heat from occupancy. With steam heat, which does not lend itself readily to central regulation, automatic devices for individual rooms are necessary in rooms occupied by a number of persons who are not expected to pay attention to the heating service. In other cases some form of graduated hand control of local radiation may be suf-

ficient. Sometimes fair service can be obtained by the use of long distance devices, facilitating better control of a plant by the engineer from a central point. With hot water heating, automatic regulation is desirable, mainly in rooms that will be crowded on occasion. On the whole, it is easiest with that system to maintain equable conditions. Still better results could be obtained by using gas for fuel in house heating boilers, as is done for bath heaters. The additional operating expense is no longer prohibitive in view of the saving in labor and other advantages. This combination of gas with hot-water heat should be the ideal domestic plant of the future. In this connection it is well to remember that the best heat regulation is often set at naught by some extraneous heat source, such as a hot flue, or a warm floor. All such cases should be looked out for in planning and taken care of.

COOL AIR IS MORE WHOLESOME TO BREATHE

Aside from the desirability of avoiding excess of heat, there is still another lesson in Fluegge's findings. It is well known that a considerable portion of the heat emitted by a human body is contained in the exhaled air. Cooler air inhaled means increased emission owing to additional heat necessary to raise it to the temperature of the body. If the air is cool and sweet besides, it will be inhaled more freely and stimulate functions. Hot and dusty air makes more labor in breathing, gives less oxygen, if only for the same volume, and keeps circulation below the normal. It follows that the lowest air temperature compatible with comfort is the most rational. We all know that the indoor temperature at which one may feel comfortable varies considerably, according to the temper of the occupants, with the relative humidity and other conditions. But our sense of comfort is probably affected quite as much by the temperature of the surrounding objects, as they radiate heat or absorb it from the body. Thus we need less clothing on a sunny day than in cloudy weather, with equal air temperatures. This is so, because radiant heat will pass through the air and to its destination, without appreciably raising its temperature. Incidentally, it will be understood, that air is not spoilt by the heat rays, but by convection, or contact alone. For these reasons a room is apt to be most comfortable if the bulk of its walls is thoroughly warmed by continuous heating service, but the air be kept relatively cool by occasional opening of windows or by a constant inflow of sweet, uncontaminated air not heated beyond room temperature. This idea of warming the walls, or the structure, rather than the air within, is conducive to equable conditions, and reduces the tendency to overheating, by the heat sources, as well as by the air supply, as each can be regulated effectively, and will not interfere with the other. Warmer room air, on the other hand, produces a lower percentage of relative humidity, and naturally tends more to excessive dryness and dust pollution by heating.

For the same reasons it appears to be more advantageous to utilize the radiant heat of direct surfaces, rather than the heat emitted by convection. This would favor the selection of low, widely spaced, flat radiation, which is generally also more sanitary.

COOL AIR AND RADIANT HEAT VS. HOT AIR

The theory of warm walls and cool air also points towards the ideal for the solution of all heating and ventilating problems, that is, to reproduce for indoor life those atmospheric conditions which we know to be most pleasant and wholesome. A direct system with continuous service, with moderately warm, well distributed, clean surfaces giving more heat by a mild radiation than by convection, combined with a tempered air supply in some sanitary form, will certainly be the nearest approach to the mild radiant

heat of the sun and cool bracing air. Any apparatus using fresh air as a heat carrier will produce the opposite effect, resembling more the enervating sirocco, or warm, cloudy weather. In any event, such apparatus necessarily gives warmer air and cooler walls since it is the air that must heat the walls. Besides, the higher the incoming air must be heated, the more it will lose of its natural sweetness. Hot air heating also tends to produce strata of warmer air overhead and cooler air near the floor, a condition which is undesirable from the hygienic as well as the economical point of view. Again, the problem of controlling the heat without either disturbing the air supply or causing other discomforts is decidedly more complex.

There are instances, of course, where heating by air may be indicated, or permissible. The indirect method, however, should be resorted to only in such cases where the heat requirement is relatively small, so that the air supply need not be warmed to an undesirable degree which will spoil it for purposes of ventilation. The same amount of heat may, of course, be obtained with smaller volumes at higher temperature as with larger volumes at lower temperatures, but the best authorities agree that it should not be brought into a room at more than 110° F. Rietschel puts it at 104° F. This is a severe limitation for conditions maintaining here. About 120° F. would seem justified. In cases where it would still result in excessive volumes it is nearly always advisable and proper to reduce the heat requirement by extra protection.

The indirect system is often installed with the idea of securing better ventilation than is expected by direct heat alone. As a matter of fact, the air renewal in either case depends largely on the natural outward leakage afforded by the structure and the draught power of any vent flues available. The inward leakage in one case comes through the register, in the other case through walls and windows. The latter air is apt to be sweeter and purer than that from the stacks. Moreover, the window ventilation can be increased without stopping the heat supply from radiators while the draught in a hot air flue is liable to be reversed under wind action when heat is most needed. The idea of better ventilation through hot air heating is, therefore, nearly always a delusion.

On the whole, the use of the indirect method should be discouraged, especially where a constant air supply of given volume is not essential. In cases where direct radiation is absolutely objected to, there are other means of meeting the situation, for those who have command of the subject. Unfortunately, it would lead beyond the scope of this article to go into the various possibilities.

Direct-indirect heating, with the air inlets back of radiators, is also adversely affected by wind and weather, giving less air when most is needed. Proper control of temperature becomes almost impossible without shutting the inlets, which is the usual fate of these devices. A more satisfactory solution in some cases may be found in the use of very small sash ventilators, admitting fresh air directly, in as many places as possible, deflecting and diffusing it, and thus keeping the room air sweeter and cooler, with comfort depending on the radiant heat provided.

In general, radiant heat is best applied by hot water radiation, which has an average temperature of only 130° to 140° F., and is rarely unpleasant. With steam heaters, the radiation is usually too intense and too concentrated, and should be modified by greater division of surface.

HYGIENE IN VENTILATING

One cannot discuss hygiene in heating without touching on the same principles as applied to modern ventilating apparatus. Even though each should act independently, one may spoil the result of the other,

hence they must be treated in harmony. The first point to be borne in mind when designing ventilating apparatus, more especially an air supply system, is again salubrity. This must not only be made possible, or probable, but compulsory or automatic, inasmuch as the air passages are necessarily out of sight and therefore only too apt to be neglected. In order to prevent dead spaces, which form eddies in the current and create dust pockets, smooth clean metal or tile ducts should lead directly from outdoors to the tempering surfaces and fans, and from the same to the flues and registers. All passages should be of sizes to assure a fair velocity of the air current that will not allow any accumulation of dust and foreign matter at any point, from intake to room. Tempering surfaces should also be spaced for a fair speed, and should be of the kind that will present a smooth surface, completely swept by the air current. The entire system in fact should be designed with the idea of sweeping itself, or making it "clean as a whistle." This is recommended not only with the idea of avoiding all possible contamination but also in order to preserve the natural sweetness of the air, which is always destroyed in contact with organic dust stirred up by the unavoidable motion. Moderate temperature of the stacks for warming, higher speed in passing the surfaces, and lowest practicable temperature of the air supply will always tend to preserve its ozone and oxygen, that is, its life and wholesomeness.

These leading ideas should be carried out just the same, if the air is filtered, washed, humidified and ozonized. Cleanliness cannot hurt the treatment, but will often help it. In fact, all means should first be exhausted to secure fair results by salubrity. Artificial "air conditioning," as it is called, should be reserved for meeting severe conditions or unusual requirements, that is, when it is desired to improve upon the outer air for special reasons. This refers especially to moistening, which is rarely needed, if the air supply is pure and cool.

Ozone should not be regarded as a substitute for ventilation, as it does not supply all the elements required. It should be used only to help in relieving extreme, intense vitiation that would call for excessive air volumes.

Preventive medicine should be used in ventilating work not only in applying hygiene, since poor engineering may offset the effort at sanitation. It is only necessary to point out that there are frequent chances for pollution of room air from outside sources not under control, which may spoil the results, unless taken care of. Lack of provision, for instance, for effective removal of odors from kitchens, toilets, wardrobes, in other parts of the same building almost inevitably make themselves felt. It would lead too far to go into all these probabilities, but in general it is necessary to realize that highest efficiency depends on good engineering as well as on sanitation.

CAPACITY IS NOT THE ONLY REQUIREMENT

The mere capacity of an apparatus to heat, and to effect a certain renewal of air, should no longer be the only criterion of performance. The sanitary requirements must receive equal consideration, if the best results are to be obtained. It will be conceded that the average practice in the planning and installation of apparatus is still deficient in these respects. Indeed, probably the best chances for improvement in this field at the present time may be found in the application of hygiene. In any event, due attention to this subject is more likely than anything else to prevent such extremes as the establishment of open-air schools. It will also tend to overcome the frequent opposition to modern ways of heating and to artificial ventilation on the part of the medical profession, which has no doubt its basis of justification. As a general conclu-

sion it may be stated that the preventive sanitary measures advocated can only increase the efficiency and usefulness of modern installations.

Dust in City Air

By Dr. George A. Soper

Speaking recently before the Boston Society of Civil Engineers, Dr. George A. Soper, who is president of the Metropolitan Sewerage Commission of New York, gave some timely and important acts regarding his observations of the condition of the air, especially in the subways of New York. Dr. Soper makes the broad statement that he never found any dust in the city of New York that did not have iron in it. The principal features of his address are given herewith:

Closely associated with the bacteria in the causation of diseases are the solid particles which air contains in the form of dust. A committee to which I happen to belong was appointed by the American Public Health Association to draw up standard methods for the analysis of air, and reported that the physical properties of the atmosphere are of more consequence to health than the chemical or bacteriological constituents, meaning thereby to place emphasis upon the importance of temperature and humidity, and especially upon the presence of dust, which contaminated air often contains.

Dust is directly or indirectly the greatest enemy of man. Aside from the enormous cost involved in the continuous warfare which is waged against it for the sake of mere cleanness, dust is dangerous to breathe. It is dangerous to breathe, not so much on account of the microbes which it contains, as because it is dust. Physiologists assert that nothing so predisposes the delicate structures of the nose, throat and lungs to invasion by microbes of respiratory diseases and we can all bear testimony to the irritating and aggravating effect which a dust-laden atmosphere produces upon sore throats and colds which most of us experience every winter.

It is probably the very commonness of the dust evil which makes us so indifferent to it, as we must frankly confess ourselves to be. We forget that it is composed of the off-scourings of our bodies and the wear and tear of our clothing, habitations, shops, factories and streets, not to mention the comminuted refuse of our kitchens and the dessicated excrement of horses upon the public highways.

We are too indifferent to the way in which it floats in and out of our houses and contaminates the food we eat, the water we drink and the air we breathe.

GRINDERS' ROT

Sanitarians have given much attention to dust, and have divided it into several classes according to its harmful effects upon the human organism. In the dusty trades, so called, the most destructive dusts are those whose composition is most unlike the soft and yielding structure of the respiratory apparatus. The grinding and polishing of metals, and the cutting of hard stone, are, because of their dust, among the most hazardous occupations in which a person can engage.

"Grinders' rot" is a name popularly employed for the tuberculosis which commonly affects knife grinders before middle age. Pneumokoniosis is a longer and more scientific term by which the medical profession designates diseases of the lungs brought on by dust of whatever kind.

There are many dusty occupations, each with a startling mortality peculiar to itself. Upon investigation, the immediate cause of death is always found to be the same—tuberculosis and pneumonia. The

direct cause of death is disease contracted from germs thrown off perhaps by a fellow workman; the indirect cause is a pair of lungs which have lost their normal resilience and peculiar spongy texture and have taken on a hard consistency and dull, somber hue from the dust which they have absorbed. The lungs of coal miners are black, the lungs of men and women who have lived for some years in cities are gray, and the lungs of country people are a bright, healthy red.

Such being some of the conditions of contaminated air, let us glance for a moment at their remedy. We have found that the contamination of air, whether chemical, microbic or particulate, is due to its employment in some way for the use and convenience of man. Air becomes polluted just as water becomes polluted. In each case a fundamental requirement of sanitary science is ignored. From its controlling importance and universal application we may term this requirement the cardinal law of sanitation. This law demands that waste products shall be carried promptly from their source, kept always within control and be inoffensively disposed of.

It is more difficult to observe this law in dealing with air than with water, and in no branch of sanitation will it be found possible to obey it perfectly. It is, nevertheless, our duty to keep its provisions prominently in mind, for no substantial success can be accomplished otherwise.

If the waste products of our furnaces and our factories were to be kept under control until they were utilized or otherwise destroyed, consider for a moment the immense saving in money and human life which would result. If persons sick with the lesser respiratory diseases, not to mention consumptives, were to isolate themselves as much as practicable, or, at least, refrain from visiting crowded assemblages, consider the enormous saving in life and health which would follow. If the filthy dust of our streets were to be kept from our lungs by efficient methods of street cleaning, consider the progress in decency and order, not to mention health, which this reform would accomplish.

PRODUCTION OF DUST ON THE INCREASE

The conservation of health has no better field for effective operation than systematic warfare against dust. With one notable exception, the use of oil on thoroughfares and railroads, no new method of combating this evil has been developed by sanitary science in recent years, while the quantities of dust produced and the harm which it has done have enormously increased with the growth of our cities. As matters stand, the greatest dust scavenger is the atmosphere. Into it we cast the dust of our houses with the same heedlessness with which we dump our sewage into the water courses. We do not stop to think that this air must serve to ventilate our dwellings and shops, and the lungs of our children and ourselves.

IRON RUST

I found that there was produced in the New York subway one ton of dust for every mile every month from the brake shoes alone. At about the same time I estimated there was produced about a ton a mile a month on the elevated roads of New York. I did not take into account the wear on the rails or on the wheels. But so great was the wear on the rails in the subway that the Interboro Company had a special steel made for the rails. They got tired of renewing them.

(To Be Continued)

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OUR ATTENTION has been called to a singular omission in some of the published copies of the Pennsylvania compulsory ventilation law. This law, after reciting the general conditions that shall obtain in school buildings costing more than $4,000, specifies that such "school-houses shall have in each classroom at least 15 sq. ft. of floor space and not less than 200 cu. ft. of air space per pupil and shall provide for an approved system of *indirect* heating and ventilation, by means of which each classroom shall be supplied with fresh air at the rate of not less than 30 cu. ft. per minute for each pupil and warmed to maintain an average temperature of 70° F. during the coldest weather."

The omission referred to is the word "indirect," which, as will be readily seen, makes a very decided difference in the type of heating apparatus permissible for such buildings. Those of our readers who have copies of this law as published by the heating engineers' society, or as contained in the vest-pocket edition of "Ventilation Laws," may make the necessary correction by inserting the word "indirect" at the point indicated.

IN VIEW of the interesting agitation now going the rounds championing the efficacy of up-draft ventilation, as well as recirculating methods, it will be refreshing, we are sure, to our readers to note the views in this issue of an expert who comes very close to the heart of the matter in his discussion of "What is the Matter with Modern Heating Practice?"

The art of ventilation may be making slow progress, but its elements, at least, are pretty well established. The present agitation is strongly reminiscent of the earliest days of the art when most of the schemes now proposed were subjected to exhaustive tests, the results of which are of permanent record. It is rather by fixing attention on such phases of the subject as are discussed in the article referred to that real progress is to be attained.

IN a discussion on "The Location of Direct Radiators," by Frederick Dye before the (British) Institution of Heating and Ventilating Engineers and appearing in THE HEATING AND VENTILATING MAGAZINE for December, Mr. Dye's name was inadvertently spelled "Nye." Mr. Dye is a well-known author of a number of works on heating and plumbing, including "Plumbing and Sanitation," "Warming Buildings by Hot Water," "Steam Heating," "Hot Water Supply," and "Popular Engineering."

Legal Decisions

Contract Completed by Third Party

In an action for a balance for furnishing and installing a heating plant in a house it appeared that the owner had given the contract to a third person, who defaulted. The plaintiff, who had the contract for the plumbing of the house, was asked to complete the heating plant. The owner insisted that the plaintiff assumed the original contract, including the price. The plaintiff insisted that he only agreed to install the plant, thus completing the contract, but without any agreement as to the price. Upon the trial he elected to recover the reasonable value. There was a sharp conflict in the evidence as to the terms of plaintiff's agreement, but the court found in his favor that there was no agreement as to price, and for the reasonable value of the labor and material. On appeal the court's findings were held to be justified by the evidence.

Chas. Wilkins & Co. vs. Sublette, Minnesota Supreme Court.

Extra Work Not Included in Contract for Installation of Steam Heating Plant

In this case, which was an action for goods sold, it appeared that the plaintiff furnished some patent valves on the risers of a steam heating plant in the defendants' property. As to this there was no dispute. The plaintiff furnished these goods on an order of the defendants' architect, and their reasonable value, according to the proof, was $50. The defendants claimed that while they directed the architect to order the installation of the goods, they thought the work was covered by another contract between them and the plaintiff for the installation of a general steam heating plant.

No provision was made for the installation of the valves in the original contract between the plaintiff and the defendants. Therefore the work, if ordered by the defendants, was extra work unquestionably. The defendants gave evidence tending to show that they had requested their architect to make provision for the valves in the original contract; but as no such provision was actually made, it was held that they could not defeat the right of the plaintiff to recover for work and materials furnished by their order, simply because their architect had omitted to follow out their wishes in the preparation of his plans and specifications for work to be done under the original contract.

Wm. H. Curtin Mfg. Co. vs. Jaeckel, New York Appellate Division, 125 N. Y. Supp. 1010.

Building Contractors' Failure to Install Ventilators Where Not Intentional

The contractor for the erection of a schoolhouse sued on quantum meruit for work and materials furnished therefor. The defense was that the building was to be erected according to plans and specifications and that the contractor had failed to follow them in that he did not install ventilators. It was held that it was a question of fact for the jury whether the omission of the ventilators was intentional and willful. If it was not, the plaintiff was held to be entitled to recover for the labor and material he had furnished, less any deduction that might be made on account of the ventilators. Their absence was not a structural defect and they could be easily supplied after the building was erected. The picture from which the plaintiff first figured the cost of the school building showed no ventilators at all. Although his contract called for them his alleged reliance on the permission of a school trustee to omit them, though unauthorized, would justify the jury in saying that there had been no intentional departure from the specifications.

Smith vs. Russell, New York Appellate Division, 125 N. Y. Supp. 952.

Interpretation of Contract to Install Heating Plant

A contract to install a heating plant, which provides that the contract shall be for "a complete and perfect job, even though every item required to make it such is not specially noted in the drawings or these specifications," and that the contractor "shall furnish all labor, tools and appliances necessary to complete his work according to these specifications, and shall perform his work in a true workmanlike manner in every particular and thus provide the building with a durable and mechanically perfect system," does not require the contractor to improve upon the plans in order to make a mechanically perfect system.

Ruddy vs. McDonald, Illinois Supreme Court.

Two Expositions in California in 1915

California is planning to hold two expositions in 1915. One will be the Panama-California Exposition in San Diego, ostensibly in commemoration of the completion of the Panama Canal but practically as a means of exploiting the resources and opportunities of the Southwest, Mexico, Central and South America. San Diego is the first port of call in United States territory north of

the Panama Canal on the Pacific Coast and it is the nearest point on Pacific tide water for the cities of the middle west and the southern states.

John C. Olmsted, senior member of the Boston firm of architects, is in San Diego, under contract to design the general character of the permanent buildings of the Panama-California Exposition and to advise regarding the landscape features of Balboa Park, which is to be the site of the exposition.

The other exposition is to be held in San Francisco and will be known as the Panama-Pacific International Exposition. The present plan is to use the water front and Telegraph and Rincon Hills for the exposition, on which it is proposed to spend $17,500,000. Many of the buildings, if the water front site is selected, will be of a permanent character. The interesting feature of the present plans is that the exposition as proposed suggests a miniature map of the entire Panama Canal.

Current Heating and Ventilating Literature

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

CENTRAL STATIONS.—Central Station at Newcastle, Ind. Osborn Monnett. Illustrated description of the mechanical equipment of a small central power and heating station. 1200 w. Power—Nov, 8, 1910. 20c.

ELECTRIC POWER SUPPLY ON THE NORTH-EAST COAST.—Illustrates and describes stations utilizing waste heat and gas. 2800 w. Ir & Coal Trds Rev—Nov. 4, 1910. Serial. 1st part. 40c.

DUST COLLECTING.—The Extraction and Collection of Dust in Manufacturing Operations. Describes the Cyclone Reform wet system, and Simon dust collectors. 2100 w. Engr. Oct. 28, 1910. 40c.

FRICTION LOSSES IN PIPES.—Frictonal Losses in Small Air Pipes. Elmo G. Harris. Gives experimental data upon the use of compressed air in small pipes, and coefficients of friction recommended for practice. 1100 w. Min Sc—Nov. 19, 1910. 20c.

HEATING GOVERNMENT BUILDINGS, WASHINGTON.—United States Capitol and Congressional Buildings. Describes the heating, lghting and power plant for the Government Buildings at Washington. 2300 w. El Rev & W Electn—Nov. 26, 1910. 20c.

The Heating of Factory Buildings. Oscar E. Perrigo. Shows the advantages of the positive heated air system and describes a typical installation. 3600 w. Ir. Tr Rev—Nov. 10, 1910. 20c.

MECHANICAL PLANTS.—Mechanical Features of the Blackstone Hotel. Illustrates and descrbes the heating, ventilation and air cooling of this new hotel in Chicago. 3500 w. Met Work—Nov. 12, 1910. 20c.

The Power Plant and Heating System of the Soldan School. The Soldan High School, St. Louis, is a 3-story and basement structure, accommodating 1,600 pupils. Illustrated description of the mechanical equpment for heating, ventilating, lighting, and supplying power for manual training and other uses. 1200 w. Eng Rec—Nov. 12, 1910. 20c.

Power Plant of McCormick Building. Osborn Monnett. Illustrated description of the mechanical equipment of this 20-story building in Chicago. 1800 w. Power—Nov. 1, 1910. 20c.

SHOP HEATING.—The Heating of Factory Buildings. Oscar E. Perrigo. Explains the advantages of the positive heated air system, describin~ a typical installation. Ills. 3000 w. Ir Trd Rev—Nov 10, 1910 20c.

STEAM PIPING.—Design and Erection of Steam Piping. Francis H. Davies. States the fundamental principles to be followed in properly laying out a piping system and discusses materials to be used to conform to good practice. 4400 w. Power—Nov 15, 1910 20c.

Power Plant Piping. Charles L. Hubbard. Deals with the subject of exhaust piping. 3000 w. Steam—Nov 1910 20c.

VENTILATING FAN.—Starting a Ventilating Fan Automatically. S. A. Worcester. Describes starting device operated by clock. 800 w. Eng & Min Tl—Nov. 5, 1910. 20c.

Isolated Plant Protective Association

As the result of a circular invitation signed by Percival Robert Moses, consulting engineer; Charles G. Armstrong, consulting engineer; John Buxton, of the Blue Room Engineering Society; S. F. Ferguson, of Mackenzie, Quarrier and Ferguson; and Charles S. Pearse, of the National Association of Steam Engineers, a meeting was called for January 16 in the Engineering Societies' Building, New York, with a view of forming an isolated plant protective association to promote publicity in favor of isolated plants, and thus counteract the publicity of the Edison and other central station companies. It is also proposed to undertake, through the new association, a movement against discriminatory rates throughout the country and also to watch legislation affecting isolated plants and promote legislation favorable to the installation of isolated plants

William Henry Bryan

1859-1910

William H. Bryan, whose death in Chicago December 5, was noted in our last issue, was 51 years old. He was born at Washington, Mo., and was graduated from Washington University in 1881. Meantime he had learned telegraphy during his vacation periods in the shops of the Missouri Pacific Railroad. In 1889 Mr. Bryan became secretary and local manager of the Heisler Electric Light Co., at St. Louis, engaged in developing a long-distance line of incandescent lighting. Since 1892 he has been engaged in the consulting mechanical and electrical engineering business in St. Louis. Among his more important designs is the power plants of the Imperial Light, Heat & Power Co. Mr. Bryan was instrumental in securing practical smoke abatement in St. Louis in 1892 and 1893 for the Citizens' Association of St. Louis.

Mr. Bryan was an ex-president of the Engineers' Club, of St. Louis, and was a member of the present Smoke Abatement Committee of the Civic League of St. Louis. He was also a member of the American Society of Mechanical Engineers and of the American Society of Heating and Ventilating Engineers.

His appointment as chief engineer to the Chicago Board of Education was the result of a competitive civil service examination in which Mr. Bryan secured the highest percentage of the large number who took the examination. His appointment was dated Nov. 28, 1910.

In society work, one of Mr. Bryan's most notable achievements was the inauguration of a movement to identify power plant piping and valves by colors. A paper on this subject which he read before a meeting of the American Society of Mechanical Engineers was published in The Heating and Ventilating Magazine for April, 1908.

At the present time the mechanical engineers' society has a committee on the identification of power house piping and at the recent annual meeting advised the appointing of a special committee on the subject to establish at the earliest possible date a standard system of coloring. The committee itself was also reappointed.

Mr. Bryan is survived by a widow and two children.

Hand-book for Heating and Ventilating Engineers

Since heating and ventilating work of buildings has become an important factor in engineering, there has arisen a demand for a hand-book which would cover the entire field and contain such tables as are commonly used in everyday practice and could be handy without searching through various text-books or current literature. Such a book has been admirably compiled by Prof. James D. Hoffman of Purdue University, Lafayette, Ind.

The book covers, in addition to steam and hot water heating, a careful and thorough study of furnace heating design—a subject which has been very little treated in text-books. The author furnishes an example of a complete design of a small house of two floors and basement plans with method of estimating ducts and sizes of registers.

The author has brought the matter of vacuum heating up-to-date, surveying the latest improved systems and devices —another subject, information on which can be found only in trade catalogues. District heating from central stations is treated in a thorough manner, including formulæ and tables for calculating the sizes of pipe and conduits.

In a similar manner are covered modern devices for temperature control. A chapter is devoted to a suggested course of instruction of heating and ventilation.

A novel feature in the make-up of the handbook is that all the useful tables are gathered together in an appendix, so that one can easily find the data wanted.

To make the book especially useful for reference, the author has given a list of references to books and current technical periodicals for continued reading at the end of each topic.

In general, we consider the book will be found just as useful for the beginner as for the engineer with considerable experience. Size, 4½ x 7 in. Pp. 322. Price, $3.50. Published by the author.

A. M. F.

Creditors Form Company to Complete Contract.

A unique case of the creditors of a failing builder stepping in and forming a company to complete the contract is reported in connection with the Pathological and Male Dormitory Building at Bellevue Hospital, New York. The success of the undertaking which resulted in the completion and acceptance of the building by the city authorities, is due in large measure to the activities of Mr. Frank A. Williams, of the heating and ventilating contracting firm of Blake & Williams, of New York.

The building in question is a $700,000 structure designed by McKim, Mead & White. The general contract for its construction was given to Thos. Cockrill & Sons. The builder failed when the building was about one-half completed and a number of creditors at once secured liens on the material already installed. At this juncture, Mr. Williams, in company with several of the other sub-contractors, organized the Bellevue

Completion Company with Francis A. Williams, president; Allston Sargent, of the Jewett Refrigerating Co., vice-president; James Elgar, of James Elgar & Co., carpenters and builders, treasurer; and Charles J. Hardy, attorney.

Through their efforts all of the liens on the building were withdrawn on the stipulation that the various creditors whose work had to be completed were to receive at least 25% of the value of the apparatus installed and work already done on the building, with payment in full for the remainder of the work as completed.

This plan was successfully carried out and the building was completed and accepted by the city December 1 last, when the final payment was made. The Completion Company collected in all about $230,000 from the city and lived up to its agreement to the letter with the other creditors, besides turning over to the receiver a handsome sum which will be added to the assets of the estate of Thos. Cockrill & Son.

The work of the Completion Company was especially appreciated by the Bellevue Hospital authorities, who were in urgent need of the facilities provided in the new building. As it stands to-day the Pathological Building is equipped with many special fixtures, etc., designed for a variety of purposes. The designing engineers of the steam heating and mechanical equipment were Nygren, Tenney & Ohmes, New York.

Heating and Ventilating System for the Oliver Building, Pittsburg

The Henry W. Oliver Building, Pittsburg, is said to be the largest and highest office building between New York and Chicago. It is 25 stories (347 feet) high above the sidewalk, and has a basement and sub-basement. The sub-basement contains the mechanical plant, work rooms, etc. The basement is divided up for use in connection with the various store rooms which occupy the first floor. Above the first floor the building is devoted entirely to offices.

Power and heat are supplied from the Oliver central power plant, which is connected to this building by a large well lighted tunnel under the street. This tunnel also connects with some 25 other buildings which are supplied from the same plant.

The heating and ventilating plant is unusually complete. The sub-basement and basement are each heated by a seperate hot blast system. The first floor is heated by hot blast and by direct radiation combined. Above the first floor direct radiation alone is used.

The three hot blast systems mentioned above supply a total of 69,590 cu. ft. of air per minute. The heating surface is made up of Vento cast iron radiation.

Between the tempering coil and fan in each case is placed a Webster air washer, built by Warren Webster & Co., Camden, N. J. By means of these air washers two sheets of water are produced in the form of a combined "rain and spray," through which all the air passes, thus removing all dust, dirt and odors. The entrained water in the air is removed by means of the horizontal baffle plates, while the spray water falls into a tank in the bottom of the air washer and, after being strained, is recirculated by means of a centrifugal pump direct connected to an electric motor.

In addition to the cleaning effect of these air washers, the intimate contact

THE OLIVER BUILDING, PITTSBURG, PA.

of the air and water results in raising the humidity of the air. In summer the use of these air washers materially reduces the temperature of the entering air.

Steam for the Vento blast heaters and for the direct radiation is circulated by means of the Webster vacuum system. A 16-in. main from the Oliver central power plant supplies all the steam for this building. Exhaust steam is used at approximately atmospheric pressure. On entering the building the 16-in. steam main divides into three branches, one supplying the blast heaters, a second supplying the radiation on the first floor and a third supplying all the radiation above the first floor. From three

branch mains the various heating units are supplied by risers and branches. The return end of each unit of radiation has a Webster water seal motor, allowing free passage to the return pipe for the air and water of condensation, but preventing the passage of steam. At all points where it is necessary to drain the steam mains a connection is made from the bottom of the steam main into the return main through a Webster dirt strainer and a water seal motor. By preventing the passage of steam into the return main the water seal motor prevents the short circuiting of the steam either through the drip points or through the radiators nearest the supply. It also permits a working vacuum to be maintained without placing an undue load on the vacuum pump.

The system of return piping is all connected into two return mains of 3-in. and 8-in. respectively, which lead to the vacuum pump. The vacuum pump is 18-in. x 16-in. in size, and is driven by a 15 h. p. direct current electric motor. Each of the two return mains above referred to is equipped with a full size Webster suction strainer, where it connects to the suction of the pump. These strainers prevent any dirt or grit from entering the pump chambers and injuring the pump. To prevent interruptions of the heat due to repairs, there are two vacuum pumps, each of sufficient capacity to handle the condensation from the entire system. Each of these pumps is completely equipped and the two are properly valved and cross-connected so that either may run at will. A vacuum of 12-in. of mercury at the pump suction is found to be ample to give circulation throughout the entire system, and this vacuum is easily maintained by the pump.

The vacuum pump discharges the water and air from the system through a 6-in. line into an air separating tank located in the Oliver power building. This tank also receives the vacuum pump discharges from the 25 other buildings heated by the Webster system from this plant. The air is allowed to escape through a vent in the top of the tank and the water goes to the feed water heater and then back into the boilers.

It may be interesting to note the following total figures in connection with this heating and ventilating system:

There are 1,634 direct radiators having a total of 71,479 sq. ft. of heating surface and weighing 488,450 lbs. (about 244 tons).

VIEW IN FAN ROOM, OLIVER BUILDING, PITTSBURG, PA., SHOWING INSTALLATION OF WEBSTER AIR WASHER

There are 140,943 lin. ft. (about 27 miles) of pipe of all sizes, having a total weight of 220,884 lbs. (about 110 tons).

85 tons of galvanized iron were used for ducts in the ventilating system, by which 69,590 cu. ft. of air are supplied to the building and 68,150 cu. ft. are exhausted every minute.

Operation of the Power Plant of the Wells Power Co., Milwaukee

The Wells Power Co., of Milwaukee, Wis., supplies customers in the heart of the business section of that city with electric current and exhaust steam for heating. The original plant was built in the basement of a business block for the purpose of supplying light, heat and power to a syndicate of several surrounding property owners, each to bear a portion of the cost of operating the plant. Later on this idea was developed further and the present company formed to make a business of selling current and exhaust steam throughout the business centre.

The original plant was soon outgrown and it was decided to add to the company's equipment by building a second plant on lines similar to the first. Accordingly the Stevenson Building, distant a few blocks from the original Wells Building, was planned with a basement power station to be operated in parallel with the old plant. The new station was built from designs furnished by the engineering firm of D. C. & Wm. B. Jackson, of Chicago and Boston, and its construction was superintended by this firm.

The new building is situated at the carner of Mason and Milwaukee streets and covers an area approximately 140 ft. square. The entire basement is occupied by the power plant and the remainder of the building is devoted to offices and stores. At present there are installed three 508 H. P. water tube boilers supplying steam to two cross-compound non-condensing vertical engines at 150 lbs. pressure. These machines each drive a 500 K. W. D. C. generator producing current at 250 volts. The usual three-wire balanced direct current system of distribution is employed, furnishing current at 240 volts for motors and 120 volts for incandescent lighting.

The main units exhaust into a heating main during the winter months and in summer to the atmosphere. All the heating systems connected onto the power company's mains are operated with a vaccum on the returns so that the back pressure on the engines rarely rises above 2½ lbs. As these engines were designed especially for these conditions, the economy at anywhere near full load is remarkably good, the horsepower being developed on approximately 20 lbs. of steam.

In order to prevent the possibility of high back-pressure on the engines and also in order to keep the load factor up, the company has adopted a policy of accepting no heating contracts without the accompanying lighting contract, although lighting will be supplied without heating. The result is that the heating and lighting loads are extremely well balanced, there being plenty of exhaust steam to supply heating except at very rare intervals when live steam from the boilers is used.

In the summer time when, of course, the heating load practically disappears the engines are still run non-condensing. This is because of the difficulty of obtaining sufficient condensing water without undue expense, due to the fact that the power plant is at a considerable elevation. Both boilers and generators stand a very considerable overload without any trouble and, due to the use of underfeed stokers, the smoke production is very light—a very valuable feature in a plant situated in as closely built up a section as is the case with this station.

A Large Pumping Contract

One of the largest contracts for pumping machinery ever placed has just been awarded to the Alberger Pump Company, New York, by the Bureau of Yards and Docks, the total sum involved being slightly over $323,000.

The contract covers pumping equipment for the three new dry docks to be constructed by the Government at New York, Puget Sound and Pearl Harbor Navy Yards, and includes, all told, eleven 54 in. vertical volute pumps, each direct-connected to a 500 H. P. induction motor, and seven 15 in. vertical volute draining pumps, each direct connected to an 85 H. P. induction motor; also all necessary suction and discharge piping, electrically-operated gate valves for the same and all electrical controlling apparatus for the motors. Three of the 54 in. units will be located at New York, while four of these units are required for each of the other docks.

Each unit is required to operate against a static head, varying from zero, when the dock is full, to a maximum of 42 to 44 ft. when the dock is completely empty, while operating at a constant speed of 219 R. P. M. without exceeding the rated horse power of the motor at any point. In addition to this, each pump is required to maintain an average capacity of 66,000 gals. per min. when emptying the dock from approximately mean high water to 1 ft. above the elevation of the keel blocks, the static head varying from zero to 32 or 34 ft. Under these conditions the contractor has guaranteed an average efficiency of 45% for New York and Pearl Harbor and 46%

for Puget Sound, these efficiencies being the ratio of the actual useful work in pumping the docks to the electrical input to the motors, and, consequently, includes all losses in the motors, pumps and piping. To meet these average efficiencies it is necessary for the pumps themselves to reach a maximum efficiency of nearly 80%.

In addition to obtaining a high efficiency, the other characteristics of the pump have to be very carefully determined in order to meet the special conditions involved in this class of work.

American Society of Heating and Ventilating Engineers

Revised List of Nominations

The ballot containing the nominations of officers in The American Society of Heating and Ventilating Engineers, as finally revised, is as follows:

FOR PRESIDENT

Reginald Pelham Bolton, New York.
B. F. Stangland, New York.

FOR FIRST VICE-PRESIDENT

John R. Allen, Ann Arbor, Mich.
S. R. Lewis, Chicago.

FOR SECOND VICE-PRESIDENT

A. B. Franklin, Boston.
R. B. Collamore, Detroit.

FOR SECRETARY

William M. Mackay, New York.
Charles E. Scott, New York.

FOR TREASURER

U. G. Scollay, Brooklyn, N. Y.
Thomas Barwick, New York.

FOR BOARD OF GOVERNORS

(Five to be elected.)

J. D. Hoffman, Lafayette, Ind.
Howard T. Gates, New York.
Aug. Kehm, Chicago.
J. A. Goodrich, Lansdale, Pa.
Henry S. Downe, London, Eng.
R. C. Carpenter, Ithaca, N. Y.
Jas. H. Davis, Chicago.
Charles G. Armstrong, New York.
L. B. Sherman, New York.
John T. Bradley, St. Louis, Mo.

American Institute of Chemical Engineers

At the annual meeting of the American Institute of Chemical Engineers, held in New York December 7-10, 1910, the following officers were elected: President, Dr. F. W. Frerichs, St. Louis, Mo.; vice-presidents, George P. Adamson, Easton, Pa.; Eugene Haanel, Ottawa, Ont.; Dr. Leo H. Baekeland, Yonkers, N. Y.; secretary, Prof. J. C. Olsen, Polytechnic Institute, Brooklyn, N. Y.; treasurer, Henry S. Renaud, New York; auditor, Herbert Hollick, Camden, N. J.

American Society of Mechanical Engineers

Officers elected at the recent 31st annual meeting of The American Society of Mechanical Engineers in New York December 6-9, were as follows: President, E. D. Meier, St. Louis, Mo.; vice-presidents, George M. Brill, Chicago; E. M. Herr, Pittsburg; H. H. Vaughan, Montreal, Can.; managers, D. F. Crawford, Pittsburg; E. B. Katte, New York; and Stanley G. Flagg, Jr.

As the election of Mr. Meier to the presidency left a vacancy in the list of vice-presidents, the matter was taken up at a later meeting of the council and Dr. Alex. C. Humphreys was elected vice-president.

The attendance at the various sessions was 633 members and 410 guests.

American Society of Engineer Draftsmen

The American Society of Engineer Draftsmen, which was founded in New York, June 18, 1910, has lately issued an interesting handbook containing, in addition to its constitution and officers, a general idea of the scope of the society and reasons why draftsmen should become members of it. It is proposed, not only to hold regular meetings at which professional papers will be read, but also to maintain an engineering library, an employment bureau for the exclusive benefit of members and the collection and distribution of all obtainable data relative to the conditions governing employment in the various drafting rooms throughout the world, as well as statistics on other subjects of interest to its members.

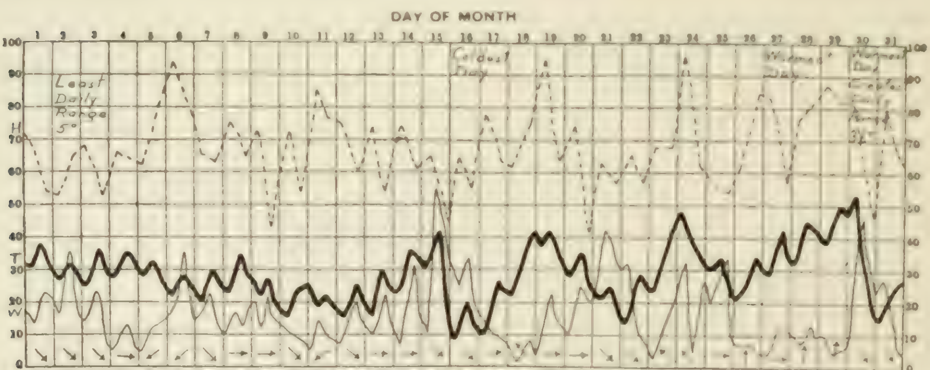
Membership in the society is extended to engineers, professors of engineering, designers, inventors, draftsmen and detailers. A junior grade of membership includes students of engineering or drafting, tracers and mechanics. Provision is made for the organization of local chapters. Dues are fixed at $3.50 per year, with an initiation fee of the same amount. The dues will be raised to $5 after 1,000 members have enrolled.

The headquarters of the society are at 116 Nassau street, New York, and the present officers are: President, E. Farrington Chandler; vice-president, William B. Harsel; secretary-treasurer, Henry L. Sloan.

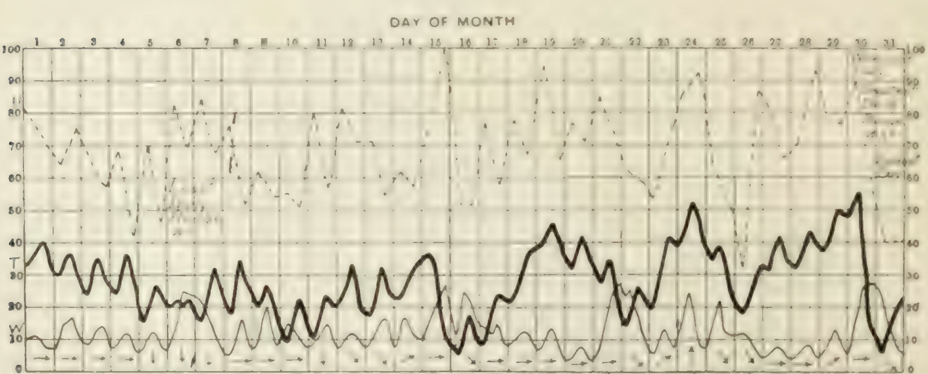
Collin Valve Co., Portland, Me., capital $100,000, to manufacture valves for water, steam, gas, etc. President, William A. Cullenan; treasurer, Harold Swett.

The Weather for December, 1910

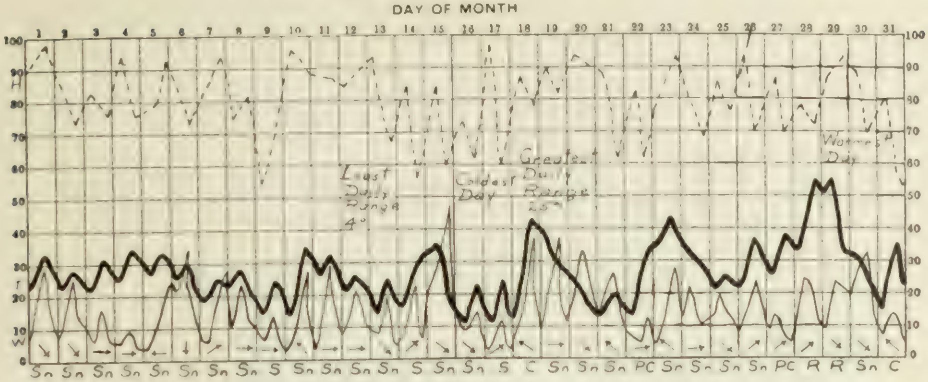
	New York	Boston	Pittsburg	Chicago	St. Louis
Highest temperature, degrees F........	53	55	55	43	54
Date of highest temperature...........	30	30	29	27	17
Lowest temperature, degrees F........	[illegible]	6	11	7	11
Date of lowest temperature...........	16	31	16	12	24
Greatest daily range, degrees F........	36	43	25	20	27
Date of greatest daily range..	30	30	18	11	14
Least daily range, degrees F...........	5	4	4	3	6
Date of least daily range..............	2	6	12	5	22
Mean temperature for month, degrees F.	28	28	27	26	32
Normal mean temp. for this month, dg. F	34.4	31	33.8	29.3	36
Total rainfall, inches.................	1.95	2.1	2.87	1.32	1.18
Total snowfall, inches.................	8.9	8.1	13	9.2	2.2
Normal precipitation, this month, inches	3.45	3.32	2.78	2.07	2.17
Total wind movement, miles..........	10555	8636	8994	10888	8617
Average hourly wind velocity, miles....	14.2	11.6	12.1	14.6	11.6
Prevailing direction of wind...........	West	N. W.	N. W.	West	N. W.
Number of clear days	12	10	4	8	14
Number of partly cloudy days	[illegible]	6	7	8	[illegible]
Number of cloudy days...............	11	15	20	15	14
Number of days on which rain fell.....	[illegible]	[illegible]	[illegible]	[illegible]	5
Number of days on which snow fell....	10	11	22	19	5
Snow on ground at end of month, inches	None	None	1.5	0.8	None



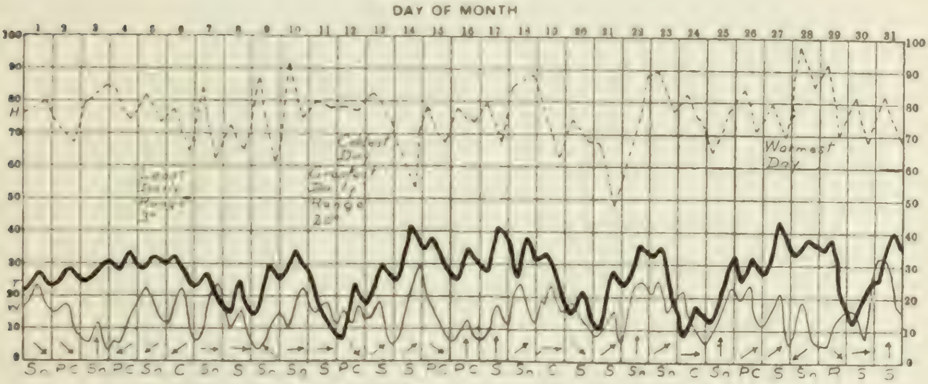
RECORD OF THE WEATHER IN NEW YORK FOR DECEMBER, 1910



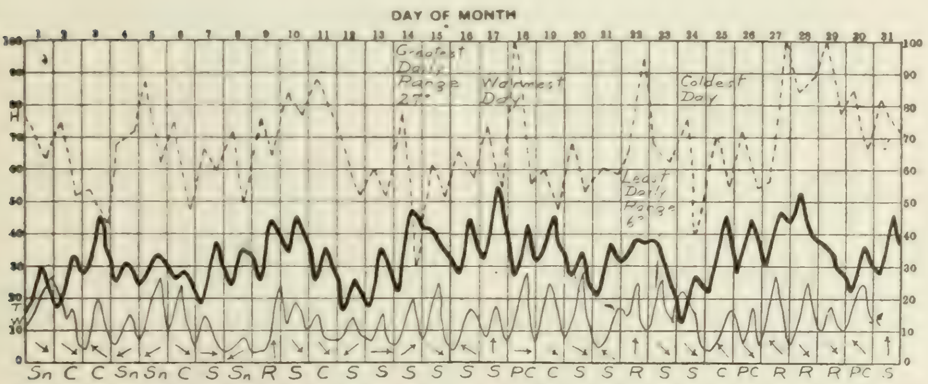
RECORD OF THE WEATHER IN BOSTON FOR DECEMBER, 1910



RECORD OF THE WEATHER IN PITTSBURG FOR DECEMBER, 1910



RECORD OF THE WEATHER IN CHICAGO FOR DECEMBER, 1910



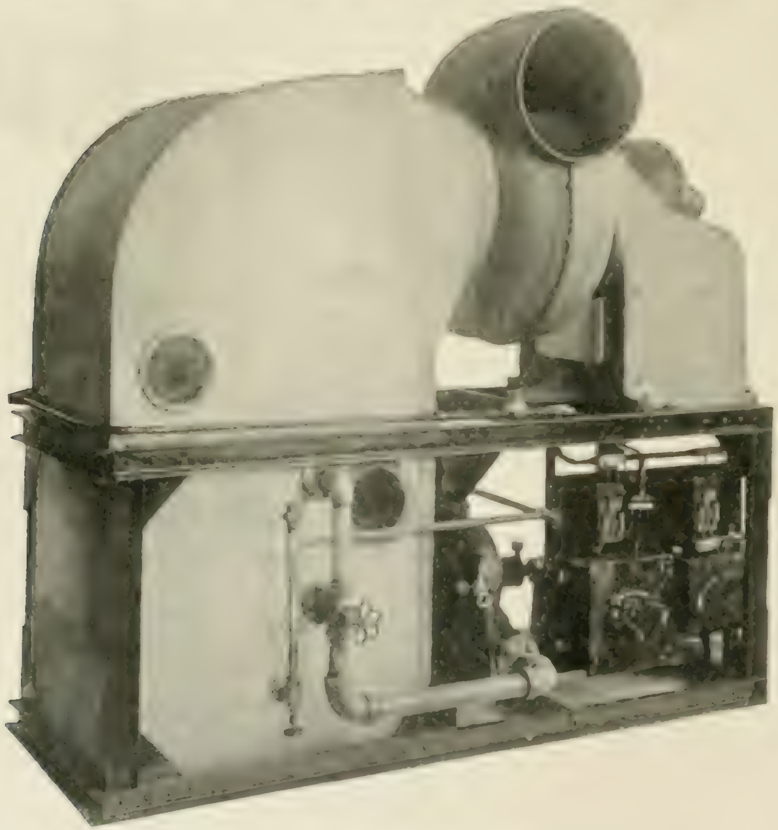
RECORD OF THE WEATHER IN ST. LOUIS FOR DECEMBER, 1910

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate relative humidity in percentagt fromireadings taken at 8 A.M. and 8 P.M.
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—Snow.
Arrows fly with prevailing direction of wind.

New Type of Self-Contained Ventilating Equipment

The need of compactness in the construction of heating and ventilating apparatus has become almost imperative in view of the increasing number of devices that now go to make up a complete installation. An important step in this direction is the self-contained ventilating equipment illustrated herewith. The feature of this unit is the combination of a McCreery air washer and motor driven pump erected on the same base with the blower. It thus requires only air, water and electric connections. By this arrangement the apparatus is able to deliver cooled air in summer, humidified air in winter and purified air all the time. The equipment is rigidly built with plate and angle iron frame and is shipped ready to run. Other noteworthy features in its construction are that all the adjustable parts are easily accessible, iron parts touched by moisture are galvanized, while the unit itself is compactly designed to fit closet or waste space. No calculations of air velocities are necessary. The blower, it will be noted, is under speed control for intermittent ventilation and, in addition, air is always purified, whether recirculated or drawn from the outside.

This equipment, which is made by the McCreery Engineering Co., Detroit, Mich., is built in seven sizes delivering from 2,000 to 7,000 cu. ft. of air per minute.



McCREERY SELF-CONTAINED VENTILATING EQUIPMENT

Atmospheric System of Steam Heating

The importance of regulating the temperature of radiators, especially in steam heating, is now recognized as one of the most important features of an up-to-date heating system. Among the successful methods of doing this and one that has won wide approval is the Atmospheric System, designed and sold by the American District Steam Co., Lockport, N. Y. This system of steam heating is based on the principle of supplying the steam to the radiator at practically atmospheric pressure in the form of vapor as a means of heat distribution. The term "atmospheric" is used to distinguish this method of heating from that of forced pressure, or vacuum systems. The supply

may be from the ordinary steam boiler, through underground mains conveying steam from a central plant, or utilizing exhaust steam. Where the supply is from a central plant, the pressure is usually reduced as it enters the building, by means of a pressure reducing valve, to

ADSCO GRADUATED RADIATOR VALVE

approximately 5 oz., and it is supplied at this pressure throughout the building. In individual boiler installations the pressure is controlled by a combined damper regulator and relief valve.

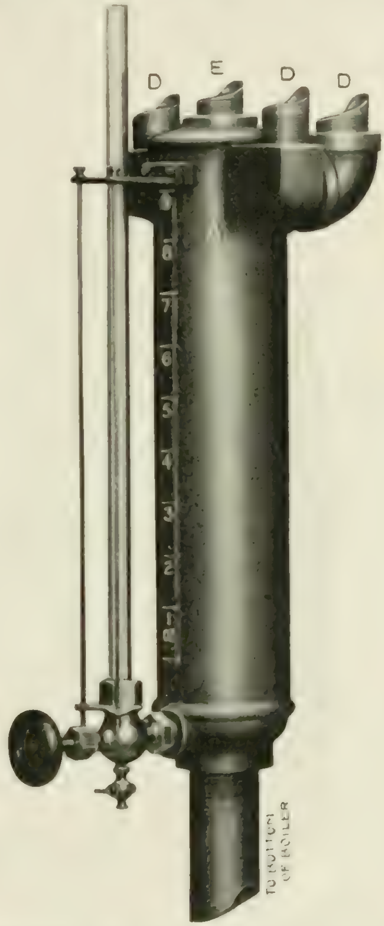
Steam is supplied to the radiator at the top through a specially constructed valve, known as the Adsco graduated radiator valve. This valve is so graduated that it is possible to supply steam to any desired portion of the radiator, up to approximately 85% of its total surface,

MERCURY GAUGE FOR USE WITH ATMOSPHERIC SYSTEM

depending upon the amount of heat required. The remaining portion of the radiator is used as hot water radiation. The water of condensation passes from the radiator into the return piping through an ordinary union elbow.

The return pipes, containing no steam, do not require covering, but are grouped into a main return and connected into an open receiver. The water of condensation passes from this receiver to the meter through a water seal and thence to the sewer, or into the underground return line of the district heating system.

If the installation be in connection with an individual boiler, the condensa-



RECEIVER FOR BOILER INSTALLATION, AT MOSPHERIC SYSTEM, GRADUATED IN OUNCES

tion is returned to the boiler through a receiver such as that shown in the illustration.

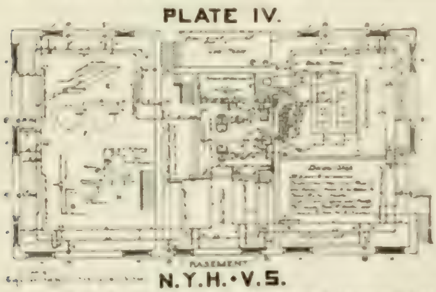
A mercury gauge, as well as a water gauge, has been designed by us for use on "Atmospheric" installations. The ordinary steam gauges are not adapted to this class of service owing to the fact that they cannot be properly graduated into ounces, and, further, for the reason that they are unreliable for the very low pressures carried in "Atmospheric heating."

These gauges are not required on individual boiler installations as the receiver illustrated is graduated in ounces and is all that is required, although if desired the mercury gauge may be installed on any riser.

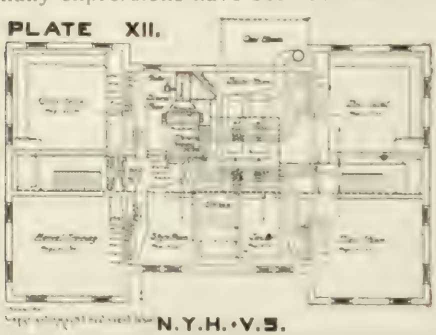
The graduated receiver is designed for use in connection with boiler installations. It is open to the atmosphere through air pipe "E" to chimney. The water of condensation and air from the radiators and piping passes into the receiver from returns at points "DDD," and from the receiver the condensation is returned to the boiler by gravity. It is graduated into ounces, each ounce representing an equal pressure on boiler. No steam gauge, therefore, is necessary.

A Remarkable Fund of Heating and Ventilating Data

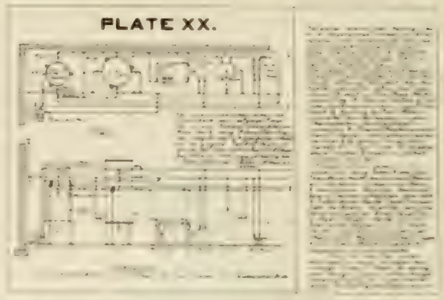
Comments on the course of instruction on heating and ventilation, which was placed on the market some time ago by the New York Heating and Ventilation School, 1123 Broadway, New York, indicate that the fund of information it contains constitutes an important contribution to the knowledge of the art. The school reports a large and growing number of students, with but one withdrawal since the school was established over a year and a half ago. The data on forced hot water heating, as well as the instruction on hot blast heating, is proving especially attractive to the students and many expressions have been received declaring that the hot water heating instruction alone is worth the cost of tuition. The school comprises many well-known heating and ventilating engineers, as well as draftsmen and heating contractors. The opinion of an experienced engineer on the course is interesting as he states that "we are none of us too old to learn and I am free to admit that many of your formulas and short-cut methods are new to me and fill more than one breach in my stock of knowledge. Where you are going to win out is in your method of teaching. You go to the heart of the matter at once in each lesson and any one who has any knowledge of the business at all has a wonderful opportunity of perfecting his knowledge through your system of instruction."



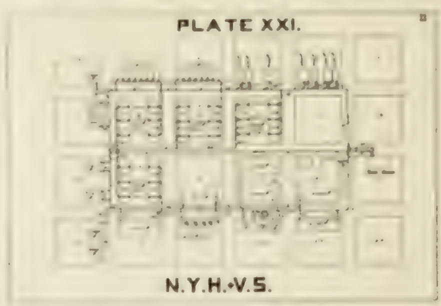
ONE OF THE PLATES IN THE LESSON ON EXHAUST STEAM HEATING



ONE OF THE HOT BLAST LESSON PLATES



ONE OF THE FORCED HOT WATER HEATING PLATES



ONE OF THE PLATES IN THE CENTRAL STATION HEATING LESSON

Another engineer, after looking over the lesson sheets, stated: "I consider that these sheets contain the most valuable data that has ever been put into print on this subject. Certainly, I have never seen anything like it and I am familiar with all the text books and instruction courses that have appeared. Any student who successfully finishes your course should have no difficulty in laying out any job he is called upon to handle."

The school publishes an interesting circular describing its methods, list of lessons, etc., which, we understand, will be sent to those asking for it.

National Volume Blowers and Exhausters

A cast-iron volume blower and exhauster that is adjustable to either right or left hand, or any desired discharge, is an interesting apparatus, manufactured by the National Blower Works, Milwaukee, Wis. The general appearance of these fans is very pleasing, and

FIG. 1.—DIRECT-CONNECTED MOTOR DRIVEN NATIONAL VOLUME FAN

the workmanship of the best. Bearings are of the ring-oiling type, babbitted and bored. The shaft is of turned steel and of ample proportions. The wheel, in the smaller sizes, has cast steel spiders; in the larger sizes the spiders have tee iron arms, cast into cast-iron hubs, and of the same general construction as the wheel used in their planing mill exhausters. Special wheels are also furnished. These may be of either sheet steel or cast iron, to suit any particular requirement. Figs. 1 and 2 show direct-connected motor driven and pulley driven fans. We are advised that further information in relation to these fans will be gladly furnished by the manufacturers.

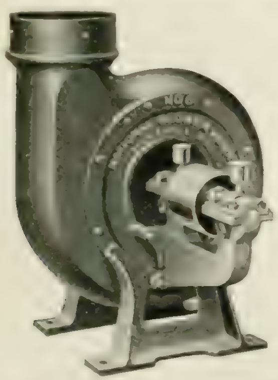


FIG. 2.—DIRECT-CONNECTED PULLEY DRIVEN NATIONAL VOLUME FAN

Trade Literature

Wainwright Water Heaters and Expansion Joints, made by Alberger Condenser Co., New York, are the subject of a new catalogue in which these devices are not only fully described and illustrated but their principles of operation are gone into at length. The catalogue contains many suggestions to the designing engineer, such as sketches showing various ways of making the pipe connections to Wainwright feed water heaters. The reading matter throughout is written on an engineering plane that cannot fail to win appreciation from those interested in this type of apparatus. In addition to the devices mentioned in its title, the catalogue also treats of Wainwright automatic controls, Wainwright heat extractors, for compressed air, oil, gas, steam or water, Wainwright anchors and guides, various types of Alberger condensers, cooling towers and turbine pumps.

Economical Fire Room Methods, by F. R. Low, is the title of Bulletin 187, Sturtevant Engineering Series, December, 1910, published by the B. F. Sturtevant Co., Hyde Park, Mass. The matter contained in the bulletin is a reprint appearing in "Power" and contains a description of the 100,000 H. P. power plant in the wood mill of the American Woolen Co. at Lawrence, Mass. In this plant the return tubular boilers are hand-fired at regular intervals with uniform quantities of coal. Sturtevant fans furnish the draft and a Sturtevant economizer reduces the temperature of the escaping gases to 200° F. and raises the temperature of the hot-well water from 105° to 185° F. A view is shown of the Sturtevant economizer as installed consisting of 792 9-ft. pipes in 72 sections of 11 pipes each, a total of 1,584 pipes to each section of the plant. The total heating surface of the economizer is 78,656 sq. ft. The fans used are of the three-quarter housed steel plate type, 16 ft. high by 5 ft. 4 in. wide. There is also reproduced a series of figures giving evaporative tests showing results seldom equalled regularly in any boiler plant. The bulletin is handsomely printed and may be had, we understand, upon request.

Ilg Portable Ventilating Sets are shown in a new illustrated circular published by the Ilg Electric Ventilating Co., Chicago and New York. These sets are designed for easy removal from place to place and are especially useful for ventilating club rooms, toilets, smoking rooms, sick rooms, vaults, kitchens, photographic dark rooms and telephone booths. The device consists of an encased fan, the fan wheel being direct-connected to a motor shaft. A galvanized iron discharge pipe comes with the apparatus, made so that it can be readily

fitted into a window panel. The makers also furnish, when desired, a flexible canvas discharge hose. The apparatus is made for both direct and alternating current and comes in two sizes, one size having a capacity of 95 to 135 cu. ft. of air per min. and the other from 160 to 320 cu. ft. of air.

CORRESPONDENCE

Takes Issue With Dr. Evans

Editor HEATING AND VENTILATING MAGAZINE.

I am compelled to take issue with the views of Dr. Evans in the article in your December issue in that, with a plenum system such as he describes, there will be a dead air zone at or near the breathing line. The writer has never found any such condition in any case where sufficient air was introduced for ventilation provided the air was admitted at a higher temperature than the normal temperature of the room. Under these conditions stagnant air is practically impossible.

Wind conditions and air leakage will sometimes cause an unbalanced and erratic distribution, but positively will not produce a stagnant zone such as described. Absolutely even heating and ventilating have been and are being secured constantly where the leakage is controlled or tight windows provided. Even heating and ventilating is an impossibility where direct-indirect radiation is used. This has been conclusively proven to those familiar with the relations of air currents in connection with heating and ventilating.

The statement that only by opening the windows and periodically "blowing" out the rooms can the bacteria content be lessened or removed is certainly a queer statement and, if true, mechanical ventilation is a farce.

How any man who seems to have such a wholesome dread of bacteria as the doctor can recommend such a prolific breeding place as a water pan on a direct radiator is beyond me and the average intake of a direct-indirect radiator is not exactly the most cleanly place to be found. Does it not seem inconsistent that the dust is to be allowed to unrestrictedly enter through these channels and through open windows while we are to shroud the blackboard erasers to get rid of some of the dust here created?

The system of heating and ventilating proposed is not new; it has been discarded long since for safer and saner methods and by no means should replace the plenum system now generally in use, such as described in the article in question. It can possibly be improved upon and will probably be from time to time, as experience dictates. Such articles as the one in question from such a high source show more conclusively than ever the need for a campaign of education in matters pertaining to ventilation, and it behooves those of us who are making an effort to get better ventilation to combat any such theories and prove their fallacy in their inception.

F. K. DAVIS.

Baltimore, Md., January, 1911.

Advertisers' Index

THE HEATING AND VENTILATING MAGAZINE

1123 Broadway | NEW YORK | February, 1911

Is the CO_2 Air Test a Fallacy?

TESTS THAT SHOW EXCESSIVE HEAT AND HUMIDITY TO BE THE PRINCIPAL CAUSES OF DISCOMFORT IN INDOOR AIR

Nothing in recent years has so startled the heating and ventilating profession as the reports of tests conducted by physiologists bearing on the contamination of air through respiration. While these tests have been going on for some time the very fact that they were conducted by men not affiliated with the heating and ventilating profession has tended to restrict a general knowledge on the part of the trade of the results of their investigations.

It now appears that the most exhaustive experiments have been conducted, both in this country and in Europe, showing the effects on the human system of breathing air of various degrees of contamination. In one sensational experiment the subject spent several days in an apartment in which the average carbon dioxide content averaged considerably over 100 parts in 10,000, and at one time rose to 231 parts in 10,000.

To Dr. Luther H. Gulick, in charge of the department of child hygiene of the Russell Sage Foundation, must be given the credit of bringing these researches squarely before the ventilating profession. His address at the recent meeting of The American Society of Heating and Ventilating Engineers, in which he recounted in detail the experiments referred to, came as a thunderbolt from a clear sky to most of those who heard it, and the eagerness expressed by many to know more of the particulars of the experiments indicated the importance attributed to the disclosures as well as the meagre publicity that has been given them.

Among the more important researches to which Dr. Gulick referred are those conducted at Wesleyan University by Prof. F. G. Benedict and Prof. R. D. Milner. In these tests a man was confined in a metal-walled chamber through which a current of air was caused to pass. In this chamber, which was 7 ft. long, 6 ft. high and 4½ ft. wide, and containing 1,790 cu. ft. of air space, subjects were tested under almost every conceivable condition of air supply. The temperature of the air current was carefully regulated and was kept practically constant at 20° C. (68° F.). The approximate relative humidity of the air in the chamber was about 75%, during periods in which the subject exercised, although at other times, especially at night, it was much lower.

The chamber, it will be noted, was sufficiently large to allow a man to stand or lie down at full length, or even to move about to a limited extent. In one end was an opening

through which the subject entered. During the experiment this was closed by glass, tightly sealed in place, and ber was a chair, table and bed, all of which could be folded and put aside. For experiments in which muscular

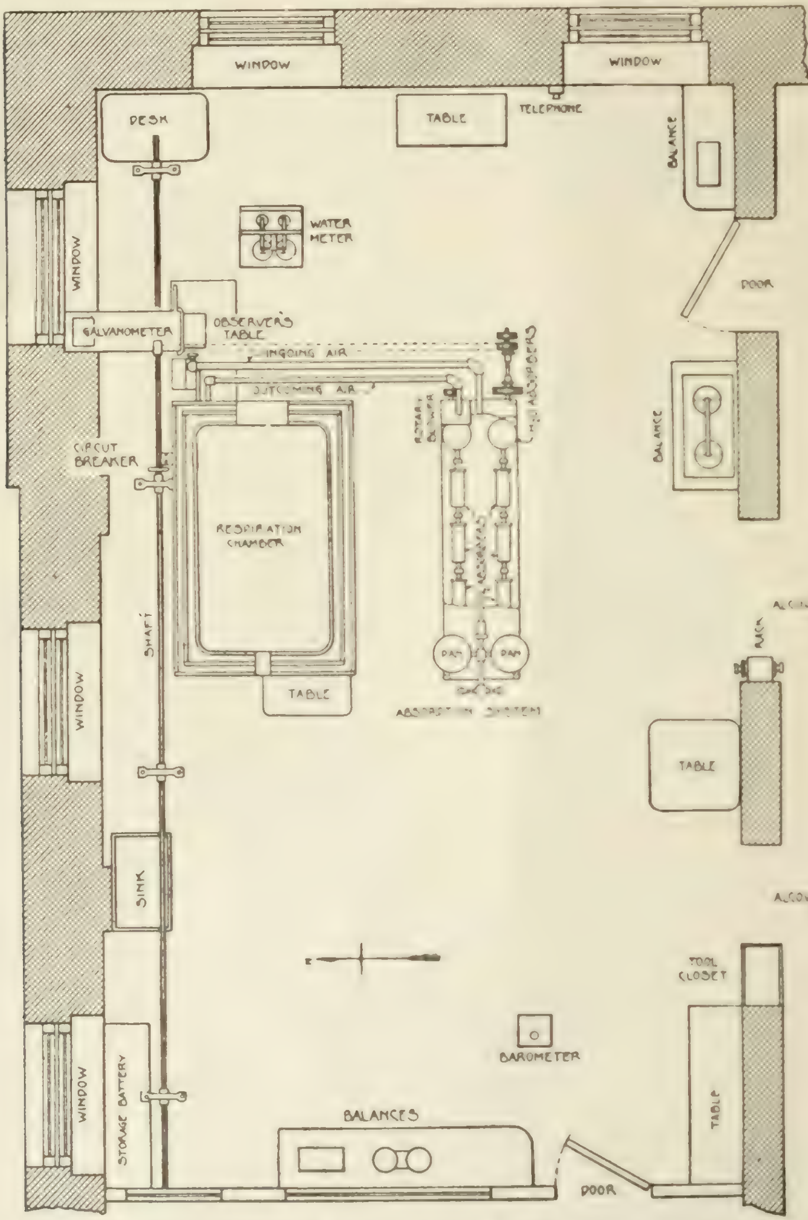


DIAGRAM OF RESPIRATION CALORIMETER LABORATORY AT WESLEYAN UNIVERSITY, SHOWING INSULATED CHAMBER USED IN EXPERIMENTS

served as a window, admitting ample light for reading and writing. In the opposite end of the chamber was a food aperture, while within the cham- work was performed a device was provided by means of which the amount of work done might be measured.

In the various experiments 17 men

lived in this chamber for periods varying from 3 hours to 13 days, and in no case was there complaint of discomfort.

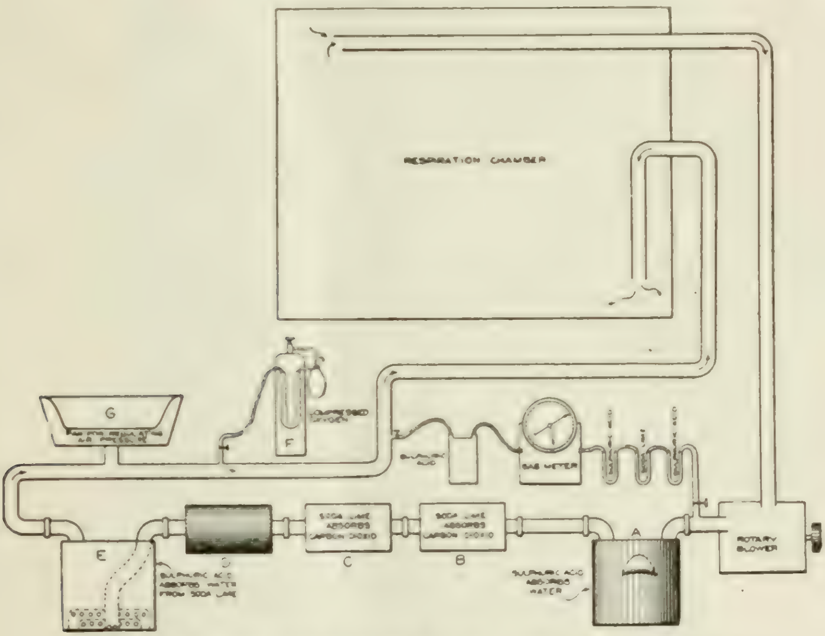
THE STANDARD VENTILATION REQUIREMENTS COULD NOT BE FULFILLED

Working on the standard of furnishing 3,000 ft. of fresh air per hour to the subject it would have been necessary to maintain an air current sufficient to supply the chamber with 3,000 cu. ft. of pure air per hour. This would have required the complete change of air in the apartment about every 4 minutes.

Such a requirement was impracticable. During some preliminary experiments it was found that persons could remain several hours in the air-tight chamber with no air passing through it with no special discomfort other than that produced by a rise in temperature. When a cooling system was introduced, in the shape of a cold water pipe extending around the chamber near the ceiling, to remove the heat and keep the temperature comfortable, the absence of ventilation was not noticeable for several hours longer.

For many of the experiments an air pump was so adjusted as to draw about 100 liters (610 cu. ft.) of air per minute through the chamber, an amount only about one-twelfth of that required by authorities on ventilation. No discomfort was felt by the subject after a stay of a number of hours in the chamber with this rate of ventilation.

The first extended experiment was made with a subject who, fortunately, did not realize the nature of the test. He slept with accustomed regularity, and no abnormal conditions of any kind developed during the night. In the morning after the first night in the chamber he was so well and contented that the experiment was continued for 2½ days without interruption or break of any kind. His health was not only excellent when he came out but continued so. A second experiment of equal length was made with equally satisfactory results.



SCHEME OF RESPIRATION SYSTEM USED SHOWING ARRANGEMENT OF AIR INLETS AND OUTLETS IN RESPIRATION CHAMBER

A third experiment was carried on with a different subject who had assisted in those proceedings. The rate of ventilation was reduced from 100 to 75 liters (610 cu. ft. to 457 cu. ft.) per minute. The subject was not aware of this reduction, and believed that he was receiving the full amount of the previous experiments. This experiment continued for five days, and at the end the subject felt perfectly well and ready to repeat the experiment.

For the fourth experiment another assistant volunteered as subject, and a much more elaborate test was planned to continue unbroken for 12 days. Heretofore, both subjects had been at rest, but in this case the subject devoted his time during the first part of the experiment to intense mental work. During the second period he remained as quiet as possible, and during the last period he engaged in severe muscular work.

Unknown to the subject the ventilating current was reduced to 55 liters (335 cu. ft.) per minute shortly after the experiment began. In spite of the fact that the daily carbon dioxide production rose from 800 grams on the day of rest to 1,400 grams on the days of work, and remained at that amount for three successive days, no discomfort was felt by the subject.

On opening the window of the chamber after an experiment the air invariably smelled "close" to an outsider, yet it is unnoticed by the subject himself. On several occasions a blood count was made before and after the experiment to determine if any anæmic tendency was developed, but in all cases the results were negative. Physically and mentally the subjects were apparently entirely uninfluenced by the long sojourn in the vitiated atmosphere.

CONTAMINATED AIR THAT RAN AS HIGH AS 231 PARTS IN 10,000

It is interesting to note that during the greater number of days of all of the foregoing experiments the minimum amount of carbon dioxide was about 35 to 37 parts per 10,000, which means that during the experiments here reported the subjects were living in an atmosphere with a carbon dioxide content generally more than twelve times normal. In one case as high as 231 parts per 10,000, or nearly eighty times normal, were found. For the twelve hours of each work day the subject lived, in general, in air with an average carbon dioxide content amounting to considerably over 100 parts per 10,000, or over thirty-three times normal.

AMOUNT OF CO_2 EXCRETED BY BODY DIMINISHED IN VITIATED ATMOSPHERE

As the quantity of carbon dioxide in the air in the chamber was at times quite large, it is probable that this condition of the air results in a disturbance of the respiratory exchange of man, causing a diminished excretion of carbon dioxide from the body. Emphasis was laid on this point by Dr. Gulick as indicating that the human body is capable, to a large extent, of adjusting itself to the surrounding conditions, including those due to vitiated air.

POISONOUS PROPERTIES OF EXPIRED AIR NOT DUE TO CHEMICAL CHANGES IN THE AIR ITSELF

Dr. Gulick reviewed the series of experiments conducted by Flugge, Heymann, Paul and Ercklentz, embodying a large amount of research work in Flugge's laboratory in Breslau on the problems involved in the question of ventilation. Previous to these experiments Formanek had presented an extended review on the poisonous properties of respired air. In this report he concluded that the presence of ammonia, resulting not from any process of normal transformation, but from decomposing material in the mouth, especially when the teeth are decayed, is sufficient to account for the poisonous properties which other investigators have found in respired air.

Flugge, in reviewing the literature of the subject, points out that the experiments of Brown-Sequard have not been verified by later experimenters, that all of the evidence thus far ac-

cumulated tends to show that there is no chemical disturbance of the respirable properties of air as a result of contamination by expired air from human beings, and that there is no gaseous emanation resulting from the transformation of matter and energy in men which has the properties of poison.

This investigator further concludes that the discomfort and disagreeable results experienced by people living in closed rooms are due principally to disturbances of the elimination of heat by the body, and to bad odors arising from the body and clothing, which, though not dangerous to health, are unpleasant, induce psychical disturbances and, consequently, should be eliminated as far as possible.

MUCH DISCOMFORT DUE TO A HOT, MOIST ENVELOPE OF AIR DIRECTLY ABOUT THE BODY

Dr. Gulick told of the investigations of Heymann, which led him to the conclusion that the air immediately surrounding the head of a person has a greater carbon dioxide content than the room air as a whole and consequently that people frequently breathe air containing relatively large quantities of carbon dioxide.

INTERIOR OF RESPIRATION CHAMBER, LOOKING FROM THE WINDOW

These results were accentuated by Paul, who made experiments in a large box in which the carbon dioxide content could be very materially increased. At times the percentage of this gas was many times that in an ordinary room, amounting often to 150 or 160 parts per 10,000. Under

this condition of excessive carbon dioxide no discomfort was experienced by the subjects until the humidity also increased.

With a relative humidity of 50% no discomfort was noticed until the temperature had risen to about 26° C. (78.8° F.). On the contrary, if the relative humidity of the air was 75% to 80% the discomfort was invariably noticed at 24° C. temperature. (75° F.).

Accurate observations of the body temperature were taken at the breast with a delicate thermo element, and measurements of the temperature and humidity of the clothing showed that as soon as the disturbance of the heat evolution of the body began there was a maximum in the temperature of the skin and an increase in the humidity on the covered portions of the body. This was the cause of disagreeable sensations which were simultaneous with the signs of discomfort noted.

This condition of the air envelope surrounding the body, as Dr. Gulick called it, was responsible in many cases for the need of air movement directly about the body, and explained why school children sitting in a room under these conditions, becoming thereby restless and languid, were benefited by having the windows thrown open and being made to march about briskly. This, said Dr. Gulick, had the effect of changing this hot, moist envelope about the body, replacing it with fresh, dry air. He even went so far as to say that these changes of temperatures and movements of air were required by the human body to maintain the highest efficiency in the operation of the organs. The body, he said, is made for a changeable temperature, and the flushing of rooms at intervals with fresh air, even with mechanical ventilating systems, is in line with the latest researches on this subject.

EFFECT OF BREATHING FRESH AIR THROUGH TUBE IN A CLOSED ROOM

Further investigations were made by the German investigator, Paul, at Breslau, which showed that if the body were inclosed in the chamber at a relatively high temperature and with increased moisture, the disagreeable effects persisted even when the inspired air was taken through a tube extending outside the chamber.

Following this, the body of the subject was placed outside the chamber and air which had previously been rendered impure by another person was breathed through a tube in the nose. In this case no discomfort was observed.

Finally, recognizing that invalids, especially in certain classes of disease, are in many cases sensitive to impure air, Ercklentz made a number of experiments with patients from a hospital, employing the apparatus, including the air-tight box, that was used by Paul. In a majority of the experiments the carbon dioxide content of the air reached from 70 to 150 parts per 10,000. Observations were made regarding the skin temperature and the temperature and moisture of the clothing. These experiments clearly showed that the chemical contamination of the air is without effect on the discomfort of men, and the only factors influencing discomfort were moisture and the temperature of the surrounding air.

FALL OF OXYGEN MUST BE BELOW 12% TO AFFECT RESPIRATORY EXCHANGE

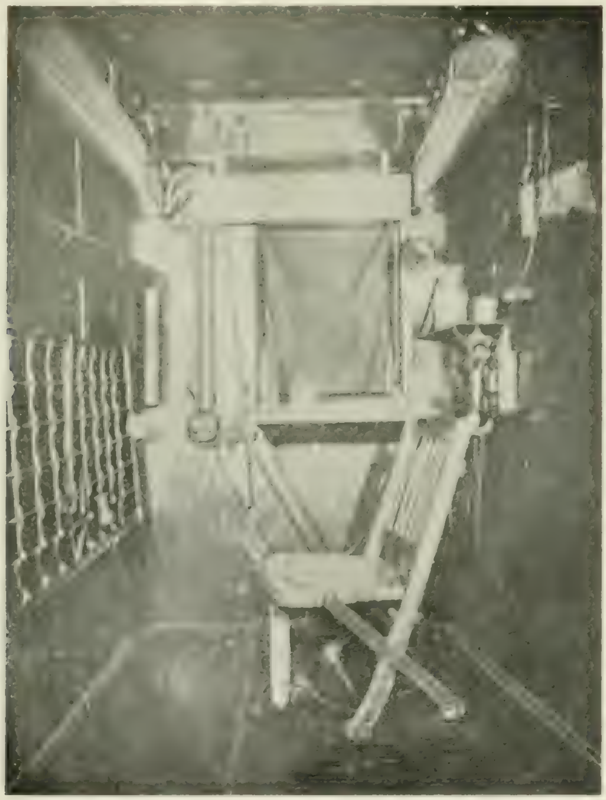
Experiments made on animals by Billings, Mitchell and Bergey with artificial atmospheres, the observations on man by Speck, and those of more recent date by Durig, in breathing artificial atmosphere containing large quantities of carbon dioxide, although experiments of but short duration, show conclusively that no marked disturbances of the respiratory exchange are noted until the percentage of oxygen in the expired air falls as low as 12%. Even in the peculiar conditions and long experiments conducted by Profs. Benedict and Milner, already described, the nearest approach to this percentage was 15.3%.

One of the most interesting experiments at Wesleyan University was one of several days' duration, on one day of which the subject breathed air through a tube from outside of the

chamber. A light tube, reinforced on the inside with a light spiral spring and provided with a rubber mask, was attached to the man's face in such a manner as to permit of his inhaling air of the chamber, which in this case remained pure because the products of respiration from both the nose and the mouth were immediately carried out of the chamber through the tube, the other end of which was attached directly to the outgoing air pipe.

The mask was of the type commonly used in laboratories to prevent inhalation of dust, the sponge used for this purpose being removed. The tube was about 8 ft. long and extremely light.

The samples from the interior of the chamber were obtained through a small opening in the food aperture. An inspection of the analyses of this air shows that the total amount of carbon dioxide in the chamber was extremely low, being only about 2 parts per 10,000. This continued until evening, when the maximum was reached at 7 P. M. of 17 parts per 10,000. On this day the subject eliminated 2,213 calories of heat and 770.68 grams of carbon dioxide and consumed 623.41 grams of oxygen.



INTERIOR OF RESPIRATION CHAMBER, FROM REAR OF CHAMBER

During the next day, when the tube was not used, the subject breathing the air inside the chamber, the carbon dioxide in the chamber was purposely allowed to accumulate rapidly, which was accomplished by cutting down the rate of ventilation to a minimum, especially during the first part of the day. The absolute amount of carbon dioxide was held at about 100 liters during the rest of the 24 hours, reaching a maximum at 10 P. M. and 7

A. M., when there were 240 parts of carbon dioxide per 10,000 in the air of the chamber.

It is thus seen that during this particular experiment the subject lived for practically the whole 24 hours in an atmosphere which at 10 A. M. was 118 parts per 10,000 and during the rest of the 24 hours averaged over 220 parts per 10,000, or over 70 times normal.

On this day the subject gave off 2,200 calories of heat and 761.43 grams of carbon dioxide and consumed 627.27 grams of oxygen. That is, when there was a very high percentage of carbon dioxide and a diminished proportion of oxygen in the air the respiratory exchange and the heat evolution were practically the same as on the preceding days when the conditions were not far from normal.

Too much stress must not be placed on the close agreement shown in this experiment, because it is assumed that the bodily activity of the subject was the same in both cases. If, on the second day, there had been a greater bodily activity than on the first, there would have been a greater carbon dioxide and heat output and vice versa.

So far as it was possible to judge, however, there were no material differences in the muscular activity on the two days, in spite of the fact that it might reasonably be inferred that the wearing of a mask and tube on the first day would tend to restrict muscular activity to some extent. It is certain that no differences in the respiratory exchange and heat output are to be noted which at all correspond to the enormous differences in carbon dioxide content.

It is also to be noted that in the case above cited no abnormal results appeared which could in any way be attributed to the increased percentage of carbon dioxide in the chamber.

In connection with the humidity in the chamber during the foregoing experiment it may be stated that when the tube and mask were worn the relative humidity was much lower than in any other experiment, as was to be expected. The lowest proportion was 25.6%, at the end of the 24 hours. Contrary, possibly, to what might be expected, the relative humidity on the next day, when the mask and tube were not worn and when the ventilation was so markedly cut down, was not abnormally high, the increase in the amount of water being in no degreee comparable to the increase in the amount of carbon dioxide.

GENERAL CONCLUSIONS REGARDING VENTILATION AS A RESULT OF THE WESLEYAN UNIVERSITY TESTS

As a result of the evidence obtained

DEVICE FOR THE REMOVAL OF THE RESPIRATORY PRODUCTS FROM THE RESPIRATION CHAMBER

at the Wesleyan University tests, Prof. Benedict and Prof. Milner made the following deductions:

1. That an increase in the amount of carbon dioxide present in the air is absolutely without effect on the mental and bodily comfort of the subjects of the experiments.

2. The so-called concomitant impurities of the earlier writers were not discovered in this research. The subjects at no time complained of headache or other discomfort. It is

conceivable that the impurities from one individual would have no deleterious effect upon the same individual, but might have on another.

3. We believe that the unusual control of thermometric and hygrometric conditions of this form of chamber preclude conditions of temperature and humidity ordinarily present in poorly ventilated roms.

The conductors of the experiments take pains to state, however, that the results must not be considered in any way as evidence in favor of a decrease in the ventilation of ordinary living rooms, lecture halls and public buildings. The great advantage to all in breathing plenty of pure, fresh outdoor air cannot be denied by anyone. The germicidal properties of atmospheric air and sunlight are of the utmost importance in conserving health.

If these experiments throw any more light upon the vexed problems of ventilation and emphasize the importance of determinations of moisture rather than of carbon dioxide, they will have been productive of good results. It is certainly erroneous and unscientific, according to these observers, to rely upon the determination of carbon dioxide in the air of a room as a measure of its condition for respiration.

The quantity would become serious, of course, when large enough to dilute the air to such an extent that the quantity of oxygen present would be insufficient for daily needs, but it can never accumulate to a serious degree in any ordinary room in which proper attention is given to regulation of the moisture content and temperature.

THE CASE OF A BULL CONFINED IN AN AIR-TIGHT STALL.

Dr. Gulick supplemented his remarks with an account of some experiments conducted at the University of Minnesota experiment station, where a bull was confined in an air-tight stall. In these experiments it became very evident that when the air was gradually contaminated the cattle acquired a very high degree of tolerance. In one case a steer, after confinement in a closed stall for 37 days, seemed to be in perfect comfort. He continued to make true gains of 1 lb. per day during the entire period. He was taken out of the stall once a week, however, to be weighed and to allow of cleaning of the stall, being out each time about 60 minutes.

In another case a steer was confined in a closed stall continuously for 28 days, the longest continuous period used at any time. This steer was not out of the stall during this time and had no ventilation except that given in feeding, which was done through a hole 14 in. x 18 in. in the door about 3 ft. from the floor. There was also a trifling amount of air leakage around the window casing and around the close-fitting door. Yet, at the end of the period, the steer appeared to be in perfect health.

The stalls used in this work had cement floors on concrete, with sewer connections, hard brick walls and board ceiling, covered with heavy muslin. The walls and ceiling were painted. The closed stall was 9 ft. x 10 ft. 8 in. on the floor and 8 ft. 2 in. high and contained 784 cu. ft. of air space. The windows were made as tight as possible. The closed stall has only one outside wall. Each stall had a door 3 ft. 8 in. wide by 7 ft. high on the north side opening into a hallway. It had one window facing the south 22 in. wide by 44 in. high. After the stall was in use for a short time very little air could enter unless admitted through the open door.

Three animals in all were used in this group of experiments, and the results were studied at ends of periods varying from 6 hrs. to 21 days. The percentage of CO_2 varied all the way to 2.67, and the relative humidity up to 99%, or practical saturation. Moisture gathered very freely on ceilings and walls and would even run down here and there in tiny streams.

In addition to this it was discovered that one of the steer's horns, which became broken, healed with the same rapidity and success as that of a steer outside whose horn was purposely broken at the same time for the purposes of comparison.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Seventeenth Annual Meeting, New York, January 24-26, 1911

Two notable results of the recent annual meeting of The American Society of Heating and Ventilating Engineers, in New York, were the acceptance by the society of a definite basis for rating house heating boilers and the virtual acceptance in principle of new theories in regard to ventilation requirements which have been brought out by recent investigators, affecting the use of the CO_2 standard as a basis for measuring air purity.

The boiler rating question is one that has engaged the attention of the society for many years. During the past two years special committees have been at work on the subject and the results they achieved have formed a groundwork upon which a final report was made and accepted by the society. The new scheme of rating is given in detail in this issue.

REGINALD PELHAM BOLTON
Newly-Elected President of the American Society of Heating and Ventilating Engineers

The agitation of the ventilation question was brought about through the presentation of two unusual papers on the subject, one on "The Value of Good Ventilation," by Prof. Severance Burrage, of Lafayette, Ind., and the other on "Standards of Ventilation," by Dr. William A. Evans, health commissioner of Chicago. In commenting on Dr. Evans's paper, Prof. William Kent suggested that the paper might well be entitled, "What I Do Not Know About Ventilation," a stand which Prof. Kent said he had been ready to assume for the past twenty years.

Following the reading of these two papers, a remarkable address was made by Dr. Luther H. Gulick, director of the Department of Child Hygiene of the Russell Sage Foundation, detailing experiments which, it was frankly declared, upset many of the accepted theories regarding the causes of the contamination of air. An elaboration of Dr. Gulick's remarks is also presented in this issue.

AFTERNOON SESSION, JANUARY 24

The meeting was called to order Tuesday, afternoon by President James D. Hoffman. Secretary Mackay announced the following new members elected since the last ballot was issued:

NEW MEMBERS

Richard W. Alger, 1225 James Building, Chattanooga, Tenn.

Alfred O. Backman, Park Row Building, New York.

Alexander S. Cameron, Chicago, Ill.

W. A. Cameron, president, Chicago, Ill.

Frank I. Cooper, 89 Franklin street, Boston.
Albert H. DeLaney, Kansas City, Mo.
Chas. F. Eveleth, 120 Boylston street, Boston, Mass.
Fred A. Forgee, 41 Park Row, New York.
Harry Geiser, Newark, N. J.
Louis R. Harding, State College, Pa.
William J. Haynes, St. Louis, Mo.
E. L. Hogan, Marquette Building, Chicago.
A. S. Humphreys, St. Louis, Mo.
H. H. Humphrey, 1505 Chemical Building, St. Louis, Mo.
Charles Kaiser, [illegible] avenue, New York.
Fred A. Leland, Springfield, Mass.
Robert [illegible], Ossining, N. Y.
Martin J. Lide, [illegible] Woodward Building, Birmingham, Ala.
Wm. H. Marshall, [illegible], N. Y.
Joseph A. Moore, State House, Boston, Mass.
Glenn C. Morgan, St. Paul, Minn.
C. E. Pearce, 437 Fifth avenue, New York.
E. B. Perrine, 120 Boston Building, Denver, Col.
Fred W. Powers, Chicago, Ill.
H. H. Rosenbaum, Chemical Building, St. Louis, Mo.
August H. [illegible], Chicago, Ill.
Cuthbert Schaffer, First National Bank Building, Chicago, Ill.
Perry West, Newark, N. J.
Frank D. Windell, Perry Building, Philadelphia, Pa.

JUNIOR MEMBER

William Mauer, Jr., [illegible] Park street, West New York, N. J.

A committee of reception was then appointed, consisting of James A. Donnelly, A. B. Marshall and William Ritchie.

President Hoffman then delivered his address, in which he spoke of the progress made by the society during the previous year, especially in the preparation of bills for compulsory ventilation of lofts, shops, auditoriums, as well as of school buildings, which will probably be acted upon by several legislatures this winter. Continuing, he said:

"Sizing up the proposition in an unbiased way, the following probably states the present conditions concerning the ventilation question: The need of pure air to maintain health is a cardinal principle, now accepted by everyone. The air we breathe contains many impurities, some of which should be eliminated to prepare it for breathing purposes. Tests to detect these impurities are rather crude and inaccurate. Present methods of supplying the air to the rooms are open to question.

"From this summary it would seem that a great many of the important points concerning ventilating air are still to be settled, and apparently the need for careful scientific investigation is very great. Some radical changes in the old and well-established methods of purifying, supplying and exhausting the air are being proposed. These changes should be carefully considered in comparison with our present methods and the future practice should be recommended accordingly."

The report of the secretary, William M. Mackay, showed an increase in the membership from 367, reported at the last annual meeting, to 390, or a net increase of 23.

The treasurer's report showed receipts to be \$5,530.78; expenditures, \$4,269.83, leaving a balance of \$1,260.95.

The report of the Board of Governors was read by Reginald Pelham Bolton and was devoted to details of the society's work.

John F. Hale reported for the Committee on Compulsory Legislation, that favorable prospects existed in several states for the passage of ventilation laws, including Colorado, Wisconsin, California, Delaware and Maryland; also Kansas, North Dakota, Nebraska and Michigan. In Ohio a code of regulations is being prepared relating to the construction, safety, sanitary conditions and maintenance of public and other buildings. Heating and ventilating is to be covered under sanitary conditions. The commission empowered by the legislature to draft this code has placed the subject of sanitary conditions in the hands of Fred. W. Elliot, an architect of Columbus, who will make an investigation of conditions in the East before making his recommendations.

The remainder of the report was taken up with an account of the preparation of a new building code in Chicago, which has just gone into effect. On this matter the report states:

A committee appointed by the Illinois Chapter of this society to cooperate with the mayor's committee and known as the Chicago Ventilating Commission, has assisted in the preparation of certain sections

of the new Chicago Building Code which has just gone into effect, and your attention is called to the following taken from the same:

ARTICLE XX.
Ventilation

680. VENTILATION IN BUILDINGS OF CLASSES IV, V, VII and VIII.

(a) The air used in any room as an auditorium in buildings of Classes IV and V, hereafter erected, and the air in any room used as an auditorium in buildings of Classes IV and V hereafter erected, and the air in any room used as a classroom or assembly hall in buildings of Class VIII, hereafter erected, shall be changed, so as to provide each person for whom seating accommodation is provided in such auditorium, classroom or assembly hall with at least 1,500 cu. ft. of air per hour.

(b) In buildings of Class VII hereafter erected on floors frequented by the public the air in such rooms shall be supplied at the following rates:

For each person in basement, 2,000 cu. ft. per hour.

For each person in first to third stories, both inclusive, 1,500 cu. ft. per hour.

For each person in fourth story and above, except as hereinafter provided, 1,300 cu. ft. per hour.

For each person in grocery departments and restaurants, 1,500 cu. ft. per hour.

(c) For the purpose of determining the number of people on any floor in buildings of Class VII, in calculating the means of ventilation, the following floor area per person per floor shall be taken as the basis:

Basement, per person, 20 sq. ft. of floor area, exclusive of walls, stairs and elevators.

First story, per person, 20 sq. ft. of floor area, exclusive of walls, stairs, elevators and enclosed show windows.

Second story, per person, 50 sq. ft. of floor area, exclusive of walls, stairs, elevators and enclosed show windows.

Third story, per person, 60 sq. ft. of floor area, exclusive of walls, stairs and elevators.

Fourth story and above, per person, 80 sq. ft. of floor area, exclusive of walls, stairs and elevators, except as hereinafter provided.

(d) Grocery departments and restaurants, per person, 40 sq. ft. of floor area, exclusive of walls, stairs and elevators.

(e) The amount of carbon dioxide in the air of any such auditorium, classroom or assembly hall or space frequented by the public in Class VII buildings shall not be permitted to rise above 10 parts of carbon dioxide per 10,000 parts of air, measurements being taken at levels from 2½ ft. to 8 ft. above the floor, generally distributed, and the temperature in such spaces when artificially heated shall not exceed 68° F. Relative humidity shall not be less than 45% nor more than 80%

(f) The air in any room used as an auditorium in buildings of Classes IV and V constructed prior to the passage of this ordinance, and the air in any room used as a classroom or assembly hall in buildings of Class VIII constructed prior to the passage of this ordinance shall be changed so as to provide each person for whom seating accommodation is provided in such auditorium, classroom or assembly hall with at least 1200 cu. ft. of air per hour.

(g) The air in any rooms and floors in buildings of Class VII erected prior to the passage of this ordinance shall be supplied by mechanical or other means, at the following rates:

For each person in basement, 1600 cu. ft. per hour. For each person in first to third stories, both inclusive, 1200 cu. ft. per hour. For each person in fourth story and above, except as hereinafter provided, 1040 cu. ft. per hour. For each person in grocery departments and restaurants, 1200 cu. ft. per hour.

(h) for the purpose of determining the number of people on any floor in buildings of Class VII, in calculating the means of ventilation, the following floor area per person per floor shall be taken as the basis:

Basement, per person, 20 sq. ft. of floor area, exclusive of walls, stairs and elevators. First story, per person, 20 sq. ft. of floor area, exclusive of walls, stairs, elevators and enclosed show windows. Second story, per person, 50 sq. ft. of floor area, exclusive of walls, stairs, elevators and enclosed show windows. Third story, per person, 60 sq. ft. of floor area, exclusive of walls, stairs and elevators. Fourth story and above, per person, 80 sq. ft. of floor area, exclusive of walls, stairs and elevators, except as hereinafter provided. Grocery departments and restaurants, per person, 40 sq. ft. of floor area, exclusive of walls, stairs and elevators.

(i) The amount of carbon dioxide in the air of any such auditoriums, classrooms or assembly hall or space frequented by the public in Class VII buildings shall not be permitted to rise above 12 parts of carbon dioxide per 10,000 parts of air, measurements being taken at levels from 2½ to 8 ft. above the floor generally distributed; and the temperature in such spaces when artificially heated shall not exceed 70° F. The relative humidity shall not be less than 40% nor more than 85%.

(j) The word "auditorium" as used in this section in connection with buildings of Classes IV and V shall be constructed as including the main floor, balcony and galleries.

(k) In buildings herafter erected for or converted to the use of a factory, mill

or workshop the air shall be changed, except as hereinafter provided, so as to provide each person for whom working accommodations are provided therein with at least 1500 cu. ft. of air per hour.

(l) In buildings used for the purpose of a factory, mill or workshop at the time of the passage of this ordinance the air shall be changed, except as hereinafter provided, so as to provide each person for whom working accommodations are provided therein with at least 1200 cu. ft. of air per hour.

(m) In any building or room hereafter erected for or converted to the use of a factory, mill or workshop, the amount of carbon dioxide in the air, except as hereinafter provided, shall not be permitted to rise above 10 parts of carbon dioxide per 10,000 parts of air.

(n) In buildings or rooms used for the purpose of a factory, mill or workshop at the time of the passage of this ordinance, the amount of carbon dioxide in the air, except as hereinafter provided, shall not be permitted to rise above 12 parts of carbon dioxide per 10,000 parts of air. The measurements in each case above enumerated in this paragraph shall be taken at the levels from 2 ½ to 8 ft. above the floor, distributed generally; and the temperature in such spaces when artificially heated, shall not exceed 68° F., except as hereinafter provided; the relative humidity shall not be less than 40%, nor more than 85%.

(o) The above provisions and standards as to ventilation shall not apply to storage rooms or vaults, or any place where the manufacturing process therein conducted would be materially interfered with, or where the manufacturing processes therein conducted would produce considerable quantities of free carbon dioxide, except that the air in such rooms or vaults or in any places of manufacture shall not be permitted to become detrimental to the health of those who enter or work therein.

(p) No part of the fresh air supplied in compliance with the requirements of this section shall be taken from any cellar or basement.

(q) No person, firm or corporation, either as owner, proprietor, lessee, manager or superintendent of any factory, mill, workshop or any other building where one or more persons are employed shall cause, permit or allow the same or any portion or apartment of any room in such factory, mill or workshop, to be overcrowded or to have inadequate or insufficient light or ventilation.

(r) No person shall be exposed to any direct draft from any air inlet, nor to any draft having a temperature of less than 60° F.

(s) All poisonous or noxious fumes or gases arising from any process, and all dust of a character injurious to the health of the persons employed, which is created in the course of a manufacturing process, within such factory, mill, workshop or laundry, shall be removed, as far as practicable, by either ventilating or exhaust devices.

REPORT OF PUBLICITY COMMITTEE

For the publicity committee, S. R. Lewis reported progress, especially in connection with the work of the Chicago Ventilation Commission, on which two members of the publicity committee served. The work of this commission is still under way, investigations being conducted into the following phases of ventilation:

1. Street cars—ventilation and devices for same.

2. Purification by ozone and elimination of odors by the same.

3. Ventilation of schools, including practical experiments with upward ventilation in a Chicago school, appropriation for which has been made by the Chicago Board of Education.

4. Requirements for ventilation and air conditioning for department stores, particularly for sub-basement selling floors.

5. Requirements for ventilation in buildings of particular occupation, such as best methods for printing offices, laundries, bakeries, restaurants, etc.

Attention was called to the rather unwieldy size of the committee and, as a result, a resolution was passed at a later session reorganizing the committee on a smaller basis.

The report of the Illinois Chapter was read by the secretary of the chapter, John F. Hale. In addition to detailing the proceedings of the chapter, reference was made to the work of a local committee of Chicago members appointed to coöperate with the Chicago Board of Health. The results of this work have been made a chapter in a book just published by the United Charities of Chicago.

BASIC VENTILATION PRINCIPLES ADOPTED BY THE CHICAGO VENTILATION COMMISSION

The report also contained fourteen basic principles regarding ven-

tilation that have been adopted by the Chicago Ventilation Commission, as follows:

1. Resolved, that carbon dioxide in the amount present in ordinary expired air does not settle out from a mixture of air and CO_2.

2. Resolved, that carbon dioxide is not the agent of pollution of major importance in expired air.

3. Resolved, that a temperature of 68° F. with a proper relative humidity, is the proper maximum temperature for rooms artificially heated and ventilated.

4. Resolved, that in the present state of knowledge it is impossible to designate the particular harmful agent or agents in or associated with expired air.

5. Resolved, that large quantities of CO_2, more than 10 parts in 10,000, when long continued, are capable of producing some harm to the human body when inhaled, regardless of the source of gas, provided the oxygen percentage is not greater than in ordinary air.

6. Resolved, that it is cheaper to heat and move air enough for adequate ventilation by currents than it is by dilution.

7. Resolved, that, neglecting humidity, the sum total of heating agencies in a room with stationary temperature is equal to radiation by the walls, ceilings, and floors, plus the heat lost with the outgoing air.

8. Resolved, that upward ventilating currents of air in crowded rooms are desirable when arising from sources free from dust or other injurious particles.

9. Resolved, that in those industries where considerable CO_2 is liberated in the process of manufacture, CO_2 is not a proper standard of air pollution.

10. Resolved, that the delivery of a certain volume of air per hour per inhabitant in a given space does not necessarily constitute ventilation.

11. Resolved, that in cold weather it is not possible to ventilate an occupied room in this climate except with air previously warmed.

12. Resolved, That heating and ventilating are separate questions and should always be so considered. When efforts are made to amalgamate them it should be borne in mind that there are parts of them that cannot be amalgamated and must be kept separate.

13. Resolved, that relative humidity is one of the most important factors in ventilation from the standpoint of health.

14. Resolved, that it is economic from a fuel standpoint to maintain a fairly constant relative humidity in ventilation.

The commission was composed of George Mehring, W. L. Bronaugh and S. R. Lewis, representing the Illinois Chapter; Prof. F. W. Shepherd, representing the Chicago Board of Education, E. O. Tonney, M.D., director of laboratories and, W. A. Stevens, M.D., commissioner of health, representing the Chicago Department of Health.

Following the reading of this report, President Hoffman appointed as tellers E. K. Monroe, B. C. Davis and H. W. Whitten.

Resolutions of sympathy on the deaths of R. Barnard Talcott, W. H. Bryan and to W. A. Green on the death of his son, H. B. Green, were adopted, to be prepared by R. P. Bolton and W. M. Mackay. An auditing committee was also appointed, consisting of James Mackay, F. K. Davis and F. D. B. Ingalls.

Before the session adjourned, it was voted to appoint a number of new committees which are given on page 16.

EVENING SESSION, JANUARY [illegible]

Tuesday evening session was opened with the reading of a paper by Byron T. Gifford on "Pipe Line Design for Central Station Heating." This was followed by the report of the rating of house heating boilers presented by the committee consisting of Edward D. Densmore, chairman, Reginald P. Bolton,

James Mackay, James A. Donnelly and Ralph A. Collamore.

The report of the tellers was then read and the following officers were elected:

NEW OFFICERS

President, Reginald Pelham Bolton, New York.

First vice-president, John R. Allen, Ann Arbor, Mich.

Second vice-president, A. B. Franklin, Boston.

Treasurer, U. G. Scollay, Brooklyn, N. Y.

Secretary, W. W. Macon, New York.

Board of Governors: James D. Hoffman, Lafayette, Ind., August Kehm, Chicago; R. C. Carpenter, Ithaca, N. Y.; James H. Davis, Chicago; John T. Bradley, S. Louis.

AFTERNOON SESSION, JANUARY 25

A special paper was presented at the Wednesday afternoon session by Frank N. Speller, metallurgical engineer for the National Tube Company, on "Durability of Welded Pipe in Service and the Prevention of Corrosion in Pipes."

The reading of the report on the interpretation of the society's constitution, which followed, led to the appointment of a special committee to revise the entire constitution.

The remainder of the session was devoted to the symposium on ventilation, already referred to.

MORNING SESSION, JANUARY 26

The programme for Thursday morning included a paper on the "Ventilation of the Capitol, Washington, D. C.," by Nelson S. Thompson, which was read by Clifford R. Bradbury.

AFTERNOON SESSION, JANUARY 26

The features of the afternoon session were a report of the effect of air leakage and wind on heating guarantees, which was read by H. W. Whitten, one of the members of this committee, and a report of the committee on legislation for New York state, D. D. Kimball, chairman, which contained a draft of the new bill covering factories, etc., which is now under consideration.

On motion of F. K. Davis, a resolution was passed by unanimous vote, expressing the appreciation of the society for the unflagging interest in the work of the society shown by the retiring secretary, William M. Mackay, who has held the office for the past twelve years.

This was followed by the installation for the newly-elected officers and the remainder of the session was presided over by the new president, Reginald P. Bolton.

After topical discussion the meeting came to final adjournment.

THOSE PRESENT

J. D. Hoffman, Lafayette, Ind.
R. P. Bolton, New York.
S. R. Lewis, Chicago.
Wm. M. Mackay, New York.
U. G. Scollay, Brooklyn, N. Y.
Judson A. Goodrich, New York.
Jas. Mackay, New York.
John F. Hale, Chicago.
R. C. Carpenter, Ithaca, N. Y.
D. S. Boyden, Boston.
F. W. Wattles, Boston.
A. C. Edgar, Philadelphia.
Roy E. Lynd, Dover, N. J.
Ed K. Munroe, Baltimore, Md.
H. W. Whitten, Boston.
J. Barton Garfield, New York.
F. V. Clark, New York.
Chas. R. Bishop, Lockport, N. Y.
C. T. Bradbury, Washington, D. C.
A. S. Armagnac, New York.
J. R. Shanklin, Charleston, W. Va.
Chas. J. Young, Poughkeepsie, N. Y.
H. Kathenbracker, New York.
Jas. A. Donnelly, New York.
Chas. Morrison, Boston.
Newell P. Andrus, Brooklyn.
Fred'k D. B. Ingalls, Syracuse.
O. W. Cushman, Cleveland.
Chas. A. Fuller, New York.
Conway Kiewitz, New York.
Geo. D. Farnum, New York.
Geo. V. Greey, New York.
F. K. Davis, Baltimore, Md.
Frank K. Chew, New York.
Harry de Joannis, Chicago.
Stewart A. Jellett, Philadelphia.
Wm. G. Snow, Boston.
C. E. Pearce, New York.
H. S. Welsh, Rochester.
H. T. Gates, New York.
F. G. McCann, New York.
W. W. Macon, New York.
W. Ritchie, New York.
Jos. Graham, New York.
D. M. Quay, New York.
Arthur Ritter, New York.
Walter Thompson, Elizabeth, N. J.
S. Morgan Bushnell, Chicago.
Edward S. Berry, Philadelphia.
A. A. Dumont, New York.
Bert C. Davis, Kansas City, Mo.
M. F. Thomas, New York.
Homer Addams, Philadelphia.
Allen Redding, New York.
L. B. Sherman, New York.
C. B. J. Snyder, New York.
A. B. Marshall, New York.
Hugh J. Barron, New York.
Louis D. Collins, Geneva, N. Y.
A. A. Cryer, New York.
Robt. Mayo, Jr., Washington, D. C.
Jas. H. Davis, Chicago.
James D. Erskine, New York.
Mark O. Monash, New York.

Wm. C. Vrooman, Schenectady, N. Y.
Richard B. Hunt, New York.
Thos. Barwick, New York.
Geo. O'Hanlin, New York.
Henry C. Mallory, New York.
L. C. Quackenboss, New York.
C. H. Seymour, New York.
J. J. McKee, New York.
T. J. Corbett, New York.
Joseph A. Moore, Boston.
Edward J. Mobley, Frederick, Md.
Jos. B. Elliott, Frederick, Md.
James W. H. Myrick, Boston.
Henry H. Lee, Boston.
Edwin H. Treat, New York.
G. E. Grimshaw, New York.
F. N. Speller, Pittsburg, Pa.
Geo. H. Schmitt, New York.
H. H. Hellerman, Philadelphia.
Wm. D. Clark, Willimantic, Conn.
F. A. Leland, Springfield, Mass.
H. K. McCloughan, New York.
T. J. Duffy, New York.
John Moster, New York.
H. B. Gombers, New York.
John F. Hanberry, New York.
Wm. H. Chenoweth, Jr., Chicago.
W. R. G. Braemer, Camden, N. J.
J. W. Curtin, Norwich, Conn.
Theo. Karr, Jr., Belleville, Ill.
P. H. Seward, New York.
W. H. Driscoll, Jersey City, N. J.
H. B. Gordon, Jersey City, N. J.
F. T. Chapman, Montclair, N. J.
David J. Rice, New York.
Jos. F. Broderick, New York.
J. A. Larocca, New York.
John G. Eadie, New York.
B. F. Stangland, New York.
Geo. B. Freeland, New York.
S. C. Porter, New York.
F. A. Wilson, New York.
Gus. Regman, New York.
Richard Hankin, New York.
Jas. A. Harding, East Orange, N. J.
O. D. B. Dewall, M. D., New York.
D. D. Kimball, New York.
J. P. Lusk, New York.
A. M. Feldman, New York.
Wm. Kent, Montclair, N. J.
W. H. McKeever, New York.
J. K. Berman, New York.
Chas. F. Scott, New York.
H. H. Brooks, Troy, N. Y.
J. I. Lyle, New York.
Perry West, Newark.
Frank L. Cooper, Boston.
B. T. Gifford, Chicago.
I. F. DeLorme, New York.
Fred'k. A. Waldron, New York.
P. A. Hoff, New York.
F. C. Bradbury, Philadelphia.
D. E. Pelglase, New York.
E. A. Stevens, New York.
Otto Reiner, Newark.
William Johnson, Providence.
C. Teran, New York.
G. Petersen. New York.
R. Rouse, Jr., New York.
E. F. Tweedy, New York.
F. T. Phillips, Philadelphia.
Albert B. Franklin, Boston.
Wm. Schoof, Jersey City.
Frank H. Lord, Irvington, N. Y.
J. C. Huldmann, New York.
F. H. Cushman, Boston.
C. A. Slocum, Long Branch, N. J.
E. C. Theis, Brooklyn.
Jas. H. Merritt, New York.
Luther H. Gulick, New York.
W. R. Fogg, Lansdowne, Pa.
J. B. Dobson, Atlanta, Ga.
Howard Newman, New York.
J. H. Textorius, New York.
W. T. Towner, New York.
E. K. Lanning, Camden, N. J.
E. K. Webster, Camden, N. J.
M. P. Miller, Camden, N. J.
Wm. F. Bilyeu, Camden, N. J.
Geo. Huey, Boston.
W. G. Le Compte, New York.
C. P. Atwood, Salem, Mass.
F. A. Hill, Baltimore, Md.
Frank Schreit, Mansfield, O.
Martin W. Kern, Providence, R. I.
A. E. Hall, Albany, N. Y.
William W. Morgan, Philadelphia.
J. Logan Fitts, Camden, N. J.
P. C. Doherty, Poughkeepsie, N. Y.
Chas. J. Hatch, Boston.
Geo. E. Rinkenburger, New York.
A. R. Manver, New York.
A. M. Alvord, New York.
H. A. Terrell, Camden, N. J.

Committees that Will Undertake Special Work during the Year

A committee in Massachusetts to serve for two years in connection with the compulsory legislation. Proposed by H. W. Whitten.

A committee of three to study the advisability of heating and ventilating guarantees. Proposed by H. J. Barron.

A committee of five to revise the constitution and by-laws, to which was referred the report of the committee on Interpretation of the Constitution. Proposed by Prof. William Kent.

A committee to confer with a committee of the American School Hygiene Association on standards of ventilation.

A publicity committee of three men from one locality to secure publicity for the work of the society and to provide for the dissemination of literature concerning heating and ventilating and subjects related thereto.

A committee of three to receive E. W. Elliott, representative of the building code commission of Ohio, who will visit the East on an inspection of heating and ventilating practice.

The Annual Dinner

The social feature of the meeting was the annual dinner which was held on the second evening, January 25, at the Grand Hotel, Broadway and 31st street. The occasion was graced by the presence of the ladies and proved a most successful affair.

President Hoffman acted as toastmaster with President-elect Reginald P. Bolton on his right and Past President William Kent on his left.

Professor Kent was the first speaker, responding to the toast, "Reminiscences." After telling of his experiences in the early days of the heating profession and of the work of such pioneers as Prof. Woodbridge, of Boston, and Prof. Baldwin, of New York, Prof. Kent reviewed the developments that led to the formation of the society. "The society," he said, "has labored under the usual defect of having a few men to carry it. Our young men have not been sufficiently taught the power of the voice. You younger engineers should cultivate the habit of getting on your feet and expressing your views in the meetings."

Speaking on "Our Present Ambitions," William G. Snow enumerated them in this order: To maintain a high standard of membership and to make the member-

ship mean more, to be ambitions to secure a wider recognition; to establish standards in heating and ventilating work; to make a greater effort in educational work; to maintain through committees closer relations with other societies; to secure greater interchange of knowledge and experience, a great dearth of information existing along certain lies; to excel in good fellowship; to be receptive of new ideas in the line of progress and to keep before the public the necessity of ventilation. Mr. Snow urged the formation of additional chapters of the society.

"Why not have our headquarters in the United Engineering Societies building?" was a sentiment he expressed which was greeted with applause. This idea, it may be added, has since been carried into effect.

President-elect Reginald P. Bolton spoke on "Our Future Policy." Mr. Bolton spoke of the critical and interesting period through which the society is now passing and predicted a brilliant future for it. He urged a wider interest on the part of the society in central station heating and expressed the hope of securing closer relations with the National District Heating Association.

"This society," he added, "has the psychological opportunity for solving the problem of the prolongation of human life and we should lead the van in the war against tuberculosis. This society has as much interest in hygiene as in ventilation and it is a matter for consideration as to whether its name might not be enlarged to include that subject."

F. K. Davis spoke for "Our New Members," and told them that the way to secure information was to inaugurate discussions by speaking freely of what they knew. "Tell others what you know," he said, "and they will probably tell you something you do not know."

E. K. Monroe was called upon to speak for "Our Near Members, the Ladies." After paying his compliments to them he renewed the proposal to hold the summer meeting on shipboard on Lake Michigan.

Bert C. Davis upheld the honor of "The Glorious West," by describing the wonderful development of Kansas City as the starting point of one of the early trade routes across the plains.

John F. Hale, speaking for "The Illinois Chapter," told of the preparation he had made for his remarks by looking up the meaning of the word "chapter," according to Webster—"Noah, not Warren," he added, a sally that the diners were quick to appreciate. He looked upon the Illinois chapter, he said, as a child of the parent body and he thought the society was in danger of race suicide unless it were to give birth to additional chapters before very long.

William M. Mackay, who is president of the St. Andrews Society of Newark, N. J., was assigned the toast of "Bobbie Burns," the day being the 152d anniversary of the Scotch poet's birth. He recited a poem on Burns with true Scotch inflection and spirit.

Harry de Joannis spoke for "The Trade Press" and, after paying his compliments to his contemporaries, he told some capital stories, concluding with expressions of the interest felt by the trade press in the projects of the society and of the desire of the press to co-operate with the society, asking only an equal degree of consideration on the part of the officers and members.

Side Lights on the Recent Heating Engineers' Meeting

Safety Cylinder Valve Co., Mansfield, O., distributed literature showing the operation of the Triumph radiator valve, with non-rising stem, in several styles, also the Triumph self-packing, graduated vapor valve. The company was represented by the president, Frank Schreit and O. W. Cushman.

Ilg Electric Ventilating Co., Chicago, Ill., provided the members with circulars describing its direct-connected electric blowers and fans, showing the construction of their unusual-shaped fan wheels or runners, as well as the company's line of Ilg automatic shutters for the protection of vent openings. Other matter described the company's self-cooled exhaust fans and portable ventilating sets.

Drop Forging Co. of New York, Jersey City, N. J., gave out circulars of its Spartan chain pipe wrenches in which the points of advantage were enumerated. A sample wrench was on exhibition.

Boynton Furnace Co., New York, had on hand copies of the Boynton Magazine for January, 1911, which contained much readable matter in the way of general philosophy as well as on the constructive merits of the Boynton line of heating apparatus.

James Spear Stove & Heating Co., Philadelphia, Pa., distributed a card of good wishes to the fraternity.

Incinerator Co. of America, New York, had on hand illustrated catalogues descriptive of its apparatus, including the Incinerite, for the sanitary disposal of garbage and refuse where it originates.

Consolidated Engineering Co., Chicago, showed a clever novelty in the shape of a celluloid-backed blotter containing a loosely fitted dial showing the applicability of the Thermo Control system of heating. By means of a red blotter for a background the effect on the radiator of different adjustments of the dial on a Thermo control valve was clearly brought out.

A Definite Basis for Rating Heating Boilers

After several years of effort the American Society of Heating and Ventilating Engineers has finally reached a definite basis for rating heating boilers. This basis is now published by the society as a recommendation to manufacturers and to the heating trade generally. Its acceptance by the trade is expected to give to the recommendations the effect of a standard, although the society specifically refrains from setting up the proposed basis as a standard.

The new method is given at length in a report of the society's committee on rating of heating boilers, composed of Edw. D. Densmore, chairman, Reginald P. Bolton, James Mackay, James A. Donnelly and Ralph D. Collamore. The report was accepted at the society's recent annual meeting in New York.

The new basis is given herewith, practically in full:

The work done by the committee on Rating of Heating Boilers has been in accordance with the following vote of the Society: "Resolved: That it is the sense of this society, that in the absence of any standard for rating of steam and hot water heating boilers, one should be established, based on coal consumption per square foot of grate surface and efficiency.

In order to determine the method of rating, it is first necessary to decide what unit will be used as the output of heating boilers, and this committee recommends that a square foot of direct heating surface be used as the unit of rating, based upon the assumption that a foot of direct steam heating surface gives off 250 B. T. U. per hour, and that a foot or direct water heating surface gives off 150 B. T. U. per hour.

In order to determine the output of any heating boiler in the form of heat it is necessary to know the heat value of the coal burned, the rate of combustion, and the efficiency of the boiler. This committee considers that it is within the province of this society to recommend a standard heat value for coal, upon which ratings shall be based, and recommends that 12,000 B. T. U. per pound of coal be that basis.

This committee considers that it is not within its province to fix arbitrarily either the rate of combustion for different sizes and makes of boilers, or the efficiency of different sizes and makes of boilers, believing that both of these are functions of the manufacturer. Consequently, this committee suggests that all ratings of heating boilers, in order to be in accordance with the standard of The American Society of Heating and Ventilating Engineers shall be based on the square feet of steam radiation or water radiation, with the values given above, accompanied by a definite and stated rate or combustion and of boiler efficiency in each case.

It must be understood that the ratings, whether based on steam or hot water surface, include not merely the actual radiators connected, but what might be called the "equivalent value" of all radiating surfaces, including piping, valves, etc., beyond the supply nozzle of the boiler and back to the return outlet of the boiler. The reason for suggesting the use of square feet or direct radiation as the basis instead of the B. T. U. is that there is thus avoided a change from the present established methods, to which the layman buyer is largely accustomed to a unit with which the layman is very much less familiar, and consequently, more puzzling.

It may be objected that this seeming simplicity of method is at the cost of a failure to take into account all the variable conditions, such as temperature of flue gases, power of draft, temperature of feed water, pressure at which steam boilers are run, etc., but in this connection it is to be noted that the efficiency of the

boiler, which is to be stated by the manufacturer, necessarily takes into account all of these things.

This committee considers itself as not warranted in going further than to suggest that the efficiency should be uniformly based on 2 lbs. of steam pressure per square inch for steam boilers and on 180° F. supply temperature for water boilers, and should assume ordinary gravity return in each case.

It is the opinion of this committee, however, that the exact conditions under which the efficiencies are to be based should be definitely determined by the society, just as the conditions under which power boiler tests shall be run and the results recorded, have been determined by the American Society of Mechanical Engineers, but this committee believes that this work should be undertaken by a separate committee on testing which should be engaged on this particular standardization alone.

In accordance with the above this committee makes the following recommendations:

1. That the unit of output of heating boilers be a square foot of direct steam radiation, assumed to give off heat at the rate of 250 B. T. U. per hour, or a square foot of direct hot water radiation assumed to give off heat at the rate of 150 B. T. U. per hour, and that for the purpose of determining the load of any reduced boiler, all of the radiating surfaces, of whatever nature, be reduced to "equivalent direct steam" or "equivalent direct water radiation."

2. That all ratings of heating boilers be accompanied by statements of the rate of combustion in pounds of coal per square foot of grate and of the efficiency of the boiler; the efficiency to be the ratio of the total heat units given off between the sup-

RATINGS OF CAST IRON BOILERS IN TERMS OF SQUARE FEET OF DIRECT STEAM RADIATION PER SQUARE FOOT OF GRATE AREA, WITH DIFFERENT RATES OF COMBUSTION AND DIFFERENT BOILER EFFICIENCIES.

Assumptions.—(*a*) Coal heat value = 12,000 B. T. U. per pound; (*b*) boiler efficiency = ratio of heat given off beyond nozzle to heat-value of coal burned; (*c*) one square foot of direct steam radiating surface gives off 250 B. T. U. per hour.

Note.—All radiating surface giving off different amounts of heat than 250 B. T. U. per hour per square foot may be reduced to "equivalent direct surface" at 250 B. T. U. per hour per square foot for use in connection with this table.

Lbs. of Coal per Sq. Ft. of Grate per Hour.	Boiler Efficiencies. (Per Cent.)										
	50.0	52.5	55.0	57.5	60.0	62.5	65.0	67.5	70.0	72.5	75.0
	Square Feet of Direct Radiation										
1	24.0	25.2	26.4	27.6	28.8	30.0	31.2	32.4	33.6	34.8	36.0
2	48.0	50.4	52.8	55.2	57.6	60.0	62.4	64.8	67.2	69.6	72.0
3	72.0	75.6	79.2	82.8	86.4	90.0	93.6	97.2	100.8	104.4	108.0
4	96.0	100.8	105.6	110.4	115.2	120.0	124.8	129.6	134.4	139.2	144.0
5	120.0	126.0	132.0	138.0	144.0	150.0	156.0	162.0	168.0	174.0	180.0
6	144.0	151.2	158.4	165.6	172.8	180.0	187.2	194.4	201.6	208.8	216.0
7	168.0	176.4	184.8	193.2	201.6	210.0	218.4	226.8	235.2	243.6	252.0
8	192.0	201.6	211.2	220.8	230.4	240.0	249.6	259.2	268.8	278.4	288.0
9	216.0	226.8	237.6	248.4	259.2	270.0	280.8	291.6	302.4	313.2	324.0
10	240.0	252.0	264.0	276.0	288.0	300.0	312.0	324.0	336.0	348.0	360.0

Example of Use of Table.—If 4 lbs. per sq. ft. of grate per hour are burned under a boiler, the efficiency of which is 60% with 6 sq. ft. of grate, what will be the capacity of the boiler? From the table, the radiation surface per sq. ft. of grate = 115.2 sq. ft., so that the total for 6 sq. ft. of grate = 691 sq. ft. of direct steam radiation.

ply nozzle of the boiler and the return outlet, to the total B. T. U. assumed to be given off by the combustion of the coal, on the basis of 12,000 B. T. U. per pound of coal, the periods between firings being stated.

3. That the committee on tests be requested by the society to standardize the conditions under which the efficiencies of heating boilers shall be determined in accordance with the above definition.

4. That the society takes steps to obtain the coöperation of boiler manufacturers in adopting the above recommendations in the rating of their boilers; that is, to have all boiler manufacturers rate their boilers as suggested above and publish the rate of combustion and the efficiency of the boiler for each rating.

Attached hereto will be found a table showing ratings per square foot of grate surface, for boilers of different efficiencies with different rates of combustion. This table has been prepared to show the range over which ratings may vary with various rates of combustion and efficiencies.

Dust in City Air

By Dr. George A. Soper

(Continued from January issue)

The consumption of iron in New York, and the resolution of the metal into dust, is the most remarkable, most disfiguring element in the city air. If you look at any of our white buildings, such as the Metropolitan Life Insurance Building, on Twenty-third street and Fourth avenue, you will see it is stained from top to bottom—stained yellow. It is stained much more deeply at the bottom than at the top. If you examine the Chemical Bank building on Broadway, you will find the same is true. But there the stain is more marked.

Our City Hall itself was cleaned by sand-blasting about three years ago, and when I entered it recently, I was struck by the deep orange color of the lower part of the building. Now that is in the center of a little park. The iron dust produced by the wear and tear of trolley cars on the surface, of those of the subway nearby and of the elevated road, not to mention the great amount of iron dust from machinery and from horses' shoes, had been carried by the air to the City Hall, and there, by the aid of moisture, had become resolved into a yellow stain.

When the Metropolitan Life Building began to be stained, I discussed the question with some of the engineers and architects of that building, and suggested to them the cause of the trouble. It is one of the largest buildings in the city, and one of the most ornamental.

Their view was that there was iron in the marble. But I went to Tuckahoe, where the marble came from, and found that houses had been built in the country not far from there of the same material and had stood many years without any stain.

And then I collected dust from the Metropolitan Building—collected it on nearly every floor up to the top, which is a great distance from the sidewalk. I always found iron particles in the dust, and always in sufficient amount to account for the results.

It would be an interesting thing for any one here who is at all concerned about dust, and curious to know how much iron there is floating around in the atmosphere he breathes, to scrape up a little dust,—perhaps from his book-case, or somewhere else in his home or office,—take a common ten- or fifteen-cent horseshoe magnet and pass it over the dust. Or, preferably, if the dust is scattered on a piece of paper,

take the magnet and pass it back and forth under the paper. In the last case with the magnet moving under the paper, the sharp eye will see some of the particles rearing themselves on their hind legs, so to speak, and waving back and forth in accordance with the amount of magnetic attraction beneath.

I have never found any dust in the city of New York that has not had iron in it. Unless dissolved by long-continued exposure to the weather, the particles retain their sharp, bladelike form.

METHOD OF PREVENTION

There is a way to prevent much of the iron dust of the subway, and that way has been employed in the Central Underground of London. The Yerkes Tubes, of London, so called, have given up iron brake shoes and use a fiber brake shoe. These brake shoes are economical and prove an excellent remedy where such an amount of disfiguring dust is produced as in the New York subway.

DISCUSSION

Dr. S. Adolphus Knopf.—Since even sterile dust from the wear and tear of the pavements and from building material, if inhaled in quantities, is apt to irritate the delicate membrane of the respiratory tract and thus make it more susceptible to the invasion of pathogenic germs, the necessity of the sprinkling and proper cleaning of streets insisted upon in Dr. Soper's paper is self-evident. Street-car companies should be obliged to have the car tracks sprinkled regularly throughout dry weather; this they can easily do by running sprinkling cars on the tracks.

Beating carpets in backyards and shaking rugs out of the windows is often a nuisance and should be retricted to certain hours. The use of the pneumatic process should be encouraged and facilitated, and the managers of all public buildings and large establishments should be obliged to use this method of cleaning. The cleaning of schools should be done by the same process. Sweeping and dusting in the old-fashioned way in our school rooms should be absolutely done away with.

While I do not exactly differ from my friend Dr. Soper when he speaks approvingly of Hessler's idea of the danger of winds to the health of human beings, I would wish also to show the beneficial action of winds. If there ever was a windy city it is certainly Chicago, yet Chicago is one of the healthiest cities in the United States, and while I gladly bear homage to the men at the head of its excellent sanitary supervision, and particularly to my good friend, the honorable commissioner of health, Dr. W. A. Evans, there is no doubt in my mind that the wind to which the city of Chicago is so much exposed, and which sweeps away all poisonous gases, is in no small degree responsible for its healthy condition. Let the builders of future cities bear in mind that a city situated on high ground, with wide streets where the winds can sweep through, will be a healthy city and relatively free from tuberculosis, pneumonia, grippe and other infectious diseases of the respiratory organs.

Prof. C. E. A. Winslow.—I have nothing to add in regard to what is so well said in the paper in regard to the dust and bacteria in the air. I should, however, like to emphasize one point to which Dr. Soper refers only briefly. The quality of bad air which we know to be chiefly important—the only quality, in fact, in regard to which we have any clear-cut experimental evidence of danger to health—is the physical quality of high temperature combined with moisture. Even here we much need further investigation, for the study of the hygiene and sanitation of the air has been perhaps the most neglected of all branches of sanitary science. It is very clear from Professor Haldane's English experiments that the crucial test of the quality of air is a reading of the wet-bulb thermometer. While very high temperatures can be endured if the air be dry, Dr. Haldane showed

that moderate physical work led to a marked rise in body temperature as soon as the wet-bulb temperature passed 78°. If at this point the mechanism of the body is so seriously upset that practically a condition of fever sets in, we may be sure that long before this there is not only discomfort, but actual danger. It is probably safe, in the light of all the facts, to set 70° on the wet-bulb as a danger point which should never be exceeded. Dr. Soper does not give the wet-bulb temperatures directly, but from figures for dry-bulb temperature and relative humidity published in the *Technology Quarterly* several years ago, it appears that during October, 1905, the wet-bulb temperature in the subway was occasionally at least between 75° and 80°. It would be of great interest to obtain readings indicating the present conditions in the subway, but the extreme discomfort one experiences in using it during rush hours is sufficient evidence that conditions are still exceedingly bad.

Dr. Geo. A. Soper.—There is no difference of opinion between Dr. Knopf and myself with reference to the effect of winds on health. It is conceivable that even a large wind movement, such as occurs in some parts of the United States, may be beneficial to health, although it is difficult to understand just how much wind is required. It is certain that without some movement of wind, life on the earth would be unendurable. We count upon natural movements of air to ventilate our cities. Our streets and houses are ventilated, not by artificial means, but by currents of air which are set up by the movement of wind from one point to another. It is surprising to see how thorough is this effect. Wind penetrates our clothing and our homes no matter how closely we may be locked up.

There is a difference between wind and draughts. My remarks concerning the possibly injurious effects of too much air movement in a subway station refer to the piercing currents of cold air which form draughts. Dr. Knopf, I am sure, will agree with me that a strong current of air, relatively small in volume and differing materially from the surrounding temperature, is not a wholesome thing to encounter and that when this condition is indefinitely repeated it may become dangerous.

Professor Winslow has called attention to a subject of large and growing importance in the matter of air analysis; that is, the part which humidity plays in affecting the health and comfort of human beings. We all know that cold and heat can be borne even when extreme, provided the air is not damp, as we say. We are so familiar with the sultry days of summer and the raw weather of winter along our coasts that it is unnecessary to speak of the disagreeable sensations which result from dampness. Most of us have a vague belief that damp weather, be it hot or cold, is unhealthy, but to many it will be new that a definite degree of humidity should have been determined beyond which injurious consequences to health result.

So far as the New York subway is concerned, the relative humidity was less in the subway than outside, and for a simple reason. The absolute humidity was about the same, but the greater heat in the subway made the relative figure less. Relative humidity means, of course, the amount of aqueous vapor which was present compared to the greatest amount which could be present, this ratio being expressed as a percentage.

The general air of the New York subway was found to be fairly good in my investigations, except for the metallic dust. The dust could largely be prevented by the use of fiber brake shoes. Such shoes have been successfully employed in Europe, but, as far as I know, have never been used in American subways. They have many mechanical advantages and are said to be fully as economical as metallic brake shoes. Fiber brake shoes are more sanitary than iron brake shoes because their dust is less harmful than iron dust.

The Value of Good Ventilation*

By Severance Burrage, Ph.D.

The widespread interest in the campaign against tuberculosis which has grown so rapidly in the last few years has served to publish the fact that one of the most important predisposing factors to tuberculosis and pneumonia is bad air. Foul air is brought about by absence of or faulty ventilation. Another fact which has been developed during this same campaign is that not only is the health greatly improved and the power of resistance of the body against disease greatly strengthened by breathing pure air, but much more efficient work is being done by those studying and working in well-ventilated rooms. The plea for good ventilation, then, may be based on two points:

First. *Health,* the prevention of unnecessary sickness and death.

Second. *Economy,* the increase in the efficiency of the occupants.

One of the common excuses for not having systems of ventilation in buildings is that they cost money. But if lives can be saved, sickness prevented, less time taken out on account of sickness, and more efficient work done in rooms or buildings where there is good ventilation, the "expense" excuse sounds very weak.

It is surprising how many buildings are not provided with any system of ventilation whatever—buildings in which numbers of individuals come together daily for several hours' continuous work or study. If such buildings are schoolhouses, the lack of ventilation, therefore bad air, can be looked upon as responsible for many deaths from tuberculosis, the children having been rendered susceptible during their school days, and dying between the ages of twenty and twenty-five—in the very prime of life. If the buildings are factories, workshops or stores, much less efficient work will be done by the occupants, much more time will be lost on account of sickness of the employees, and the employees themselves will be rendered susceptible to many germ diseases. Such buildings should be provided with ventilation. It will be economical in the end.

Sometimes there are serious faults in buildings that are provided with ventilation systems. For example, a school building may have provison for a pure air supply that only operates when the heating plant is in operation. Then the rooms are ventilated during the cold months and depend on their natural ventilation through the doors and windows at all other times. I have noticed this fault in many public school buildings. With the present availability of electricity for power to drive fans there seems to be little excuse for this. Another example: I found a recently completed hospital in one of our large cities wth the fresh air intake in close proximity to the outlet of the ventilating shaft from the kitchen and laundry.

Another and very serious fault is the failure to provide ventilation for toilet rooms in school houses and other buildings in which all the other rooms are ventilated. The very rooms that need to have the bad odors and foul air removed from them are neglected! Newly constructed college and technical school buildings have had this unsanitary condition thrust upon them.

Many buildings are provided with apparatus for supplying pure air, but with no means for regulating the amount of moisture in the air. Consequently, the air is usually too dry. An excellent discussion of the "Effect of Dry Air on Health" may be found in a paper by W. E. Watt, of Chicago, in the *American Journal of Public Hygiene,* June, 1910. In this paper the author proves that the air in many of our school rooms "is drier than that of the driest desert on the face of the earth." He goes on to say that in his school, when the rooms are provided with humidified

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air, temperature 62° to 64° F., "we are clear-headed and feel well. When the new air was introduced it cut down the number of cases of office discipline 80 per cent." "Humidified and cooler air saves one-fifth of the coal as well as adding vitality and efficiency."

These faults and defects in our ventilated and unventilated buildings should be remedied to bring about a more healthful condition, as well as to bring about more efficient and more economical operations.

IMPORTANT IMPURITIES IN INDOOR AIR

The important impurities in the air of buildings are in the form of gases, odors and dust. In the list of the gases we frequently find carbon dioxide mentioned as the most important. It rarely exists in the air in sufficient quantities to be actually poisonous to our bodies, and I believe that its importance lies only in its being a danger flag, pointing out the possible presence of other and more harmful things.

If the carbon dioxide in a room has come from the combustion of some fuel in which the combustion has not been complete, carbon monoxide may be present which is poisonous in very small quantities. Escaping illuminating gas may cause its presence in a room or building. If the carbon dioxide has come from the lungs of human beings it will then indicate the possible presence of germs of disease which will be in the rooms or buildings in the form of dust: not that the germs shall have come from the lungs, but from the bodies and clothing of the individuals.

I think too much importance has been attached to the amount of carbon dioxide in rooms. It may serve as a very crude measure of the purity of the air, but I am doubtful as to its value as a standard by which to test the efficiency of a system of ventilation. Rooms in which the carbon dioxide has been shown to be less than the maximum permitted by authorities have in some cases given rise to headaches and drowsiness.

I believe that an examination into the purity of the air in buildings where a ventilating system has been or is going to be instilled should involve much more than a simple and rather doubtful test for carbon dioxide. The humidity, the amount of dust, the number of people, the character of the employment of the occupants, the number of continuous hours occupied, the climate, the height and shapes of the rooms, the nature of the outside air, the methods and times of dusting and sweeping, all these and many other factors must be taken into account, and the system then installed which will give the best results.

It seems to me to be just as unreasonable to lay down rules or standards for ventilation systems as it is for the water works engineer to say that one method or standard of water purification must be applied to all cases. Each city has its own peculiar conditions, its own problems of water purification to solve. Just so, I believe, each building, and each room in a building, has its own problems of ventilation to solve. There should be closer connection between the work of the architect and that of the heating and ventilating engineer. More careful work will bring about more healthful and more economical conditions.

The United States Bureau of Mines

The newly created Bureau of Mines in the Department of the Interior will hereafter conduct the investigation of fuels which has heretofore been undertaken by the Technological Branch of the United States Geological Survey. The act creating the new bureau became effective July 1.

As originally approved, the law contemplated the transfer of the entire Technologic Branch, the mine accident investigations, fuel investigations, structural materials investigations, the entire personnel, property and equipment, to the Bureau of Mines, but the Sundry Civil Appropriation act, approved June 25, amended the law to such an extent that the structural materials investigations, including the personnel and equipment for these investigations went to the Bureau of Standards, Department of Commerce and Labor. The Bureau of Mines, therefore, includes the mine accidents and fuel investigations for which an appropriation of $410,000 was made by Congress.

*Standards of Ventilation**

By W. A. Evans, M.D.

The harm that is done by bad air falls into two groupings. The first is the air-borne infections, such as colds, bronchitis, pneumonia, consumption, anterior poliomyelitis, and cerebro spinal meningitis, and, in small measure, smallpox, diphtheria, measles and scarlet fever. In this group the harm which is done shows itself rather promptly. We speak of this group as quick-acting. The second group is that of air-caused conditions. They are the slow-acting intoxications causing sleepiness, drowsiness, mental hebetude, anemia, headaches, flabbiness and increased susceptibility to infections.

It has been found impossible to apply the ordinary principles of etiology to carrier mediums. For example, it is accepted that typhoid fever is milk-borne, yet no one has isolated the typhoid bacillus in any milk which was causing typhoid fever. This is true of water and air. Therefore we cannot be more specific than to say that air which has a general bacterial content over a certain figure is presumptively harmful. The same principle applies with regard to the second group.

The harmful constituents or qualities of expired air are not understood. For that matter, we canot say just what is harmful in any other excrement. Analyses and experiments with feces have never made it possible to say just what element therein causes harm; no one has ever isolated the toxic substance in urine: but it can be assumed that they are objectionable æsthetically and from the health standpoint. These things are true of expired air.

NO SINGLE STANDARD OF VENTILATION

Therefore with air there can be no single standard of efficiency of ventilation in the present state of our medical and bacteriological information. The standard must be a complex composed of standards on different qualities of air and different methods of procedure in handling the air. Some of these can be quite definitely stated; some are still so vague as to be suggestive only.

As to ventilation, is not the standard the complex standard of everything in hygiene and sanitation? For example: If a building is so located that it gets lots of sunshine in its interior, the ventilation standards can be lowered 20% with safety to the occupants. If the ventilation is of a basement where sunshine cannot get in, then the standard should go 20% over the normal, or, in a hospital, the standards must be higher than elsewhere, because the general health rate is lower; or, if people bearing potential infection are jammed very close together the standard must be higher than where occupation is very sparse; or, if hygiene and cleanliness are of a very high standard the ventilation standard can be lowered.

The standard complex theoretically should be "such that no inhabitant should be harmed immediately or ultimately by the air of the place ventilated." In order that this may be brought about it is necessary that every factor be standardized. To standardize one and leave the others untouched may or may not accomplish the result according to the laws of chance. This, however, is not scientific. A standard of ventilation must consist of many standards.

DUST CONTENT

A series of dust standards should be adopted. These standards should vary according to the harmfulness of the dust. Where the nature of the business makes organic dust, e. g., milling, the amount of dust allowed should be high. Where the business produces inorganic, inodorous dust it should be low, e. g., metal polishing. It should be intermediate where the dust is odorous, e. g., painting. It should also take into consideration

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human contamination of the dust, e. g., carpet cleaning, janitor service.

If the dust is made on the premises a higher percentage is allowable. If the dust is inorganic it is more harmful than if it is organic.

All of these factors must be taken into consideration in determining a standard. I am not sufficiently informed to suggest such standards as to quantity.

HUMIDITY

There should be humidity standards. Air which is too wet or too dry is unhealthy and uncomfortable. If it is too dry it desiccates mucous membranes; hence it determines infections. If it is too moist its conductivity is too high and it determines infections. To hold the humidity fairly uniform permits of comfort under wider ranges of temperature. It permits of more air currents.

Suggested standard: 60% to 80% relative humidity, or 10° to 20° F. maximum difference between inside and outside humidity. The method of determination is by the wet and dry bulb thermometer.

TEMPERATURE

Probably a temperature standard is the most imperative of all. It is also the most easily inspected and judged.

Whenever the temperature of the air of a room mounts higher than 70° F. the air of the aerial envelope of the human body and the air of the breathing zone has practically no tendency to displace itself. It is therefore both unhealthy and uncomfortable. If fresh air can be blown against the body or into the breathing zone with sufficient force to displace the air of these locations, higher temperatures are harmless. In other words, the body purges itself of the harmful contents of exhalation and expiration by heating the air in which they are discharged. This as a force is ample so long as the environment is, say, 65° to 68° F. and below. If the temperature of the environment passes this point harm results, unless currents of the same or greater power are substituted therefor.

SUGGESTED STANDARDS WHERE THE AIR IS FREE FROM APPRECIABLE CURRENTS

The temperature should not rise about 65° F. When the air currents are moderate the temperature should range from 68° to 70° F. When the temperature passes 70° F. the air currents should be traveling not less than ten miles an hour when they strike the body and the head zone.

Methods of gauging: Thermometers properly placed with regard to heating, lighting, occupation, radiation, convection and conduction.

CARBON DIOXIDE

In establishing a standard for carbon dioxide it is well to bear in mind certain fundamental facts:

(a) The carbon dioxide produced in the human body is a harmful agent, but it is not violently so, or immediately so; neither is it the most harmful agent or quality of expired air.

(b) It is a good index of pollution when animal life is practically the only agency of production operating in the area which is being judged.

(c) While the CO_2 produced in processes of manufacture is slightly harmful, air containing a given content of CO_2 is much less harmful than air containing the same proportion of CO_2 to animal expirations.

(d) CO_2 is a readily diffusible gas, and therefore in a given room the proportion of CO_2 is the same at all points, regardless of temperature conditions and location of agencies of production. Diffusion requires a little time; therefore, in a room with uprising air there is a slight excess at the ceiling, there is a slight excess at air outlets regardless of whether they are located at the floor or the ceiling. As it is impossible to keep all the air around lights, etc., from rising, there is always a very slight ceiling excess even in downward ventilation installations.

Therefore, the amount of CO_2 in a room should not pass ten parts per 10,000, if it is all being produced by animals. If it is being produced by other agencies it can pass this figure.

It should be regulated for each industry. For example, in the brewing industry the CO_2 will probably be unassociated with any other harmful substance, therefore it could safely be allowed to pass 30.

In brick burning it would probably be associated with considerable SO_2, therefore 15 would not be compatible with comfort.

Methods: The Rogers modification of the Peterson-Palmquist apparatus is the best thing we have.

There is great need for some simple approximate test.

ODORS

It is impossible to standardize odors. The personal equation is so large a factor that no certain rules can be applied. Generally speaking, odors do good rather than harm. In order to be rid of them ventilation becomes masterful; under practically every other circumstance it is suggestive. Under ordinary circumstances we think the air should go in a certain direction, and we persuade it to go there more or less mildly. When there are odors we force it to go where it should go. In that odors make for ventilation they do good. The aromatic substances which we ordinarily encounter are not at all toxic immediately or remotely in the doses in which they are contained in the air. If, on the other hand, for example, the odor of the stock yards is objected to by a woman, and if she tries to lessen them by putting down the windows, she will get bad ventilation in her home and thus be indirectly harmed.

Another indirect effect of odors is this: Cooking odors are not at all harmful. They are not objectionable to some people at any time. To other people they are welcome at some times and objectionable at others. Nevertheless, a hotel which allowed its kitchen odors to get into its bedrooms would be avoided by the traveling public. Again, the cooking odors which come from the stock yards are not harmful, yet a man renting or buying a house, and being under no compulsion to rent or buy in an odorous neighborhood, would not do so. From the standpoint of odors there is but one thing to do and that is, to make the premises as nearly neutral as possible. Beyond this no standardizing is possible.

The removal of odors is easy where the odoriferous air is warm. For example, in a kitchen. Here the method is direct and immediate upward removal, so placed that cross currents are reduced to a minimum. On the other hand, the odor of ice boxes is removed by direct downward flow of air. If the temperature does not aid, as, for example, in a shoe establishment, a paper establishment, a small ice box installation, a reading-room in a library or other place with many body odors, about the only available method is periodic blowing out by wind through open windows, or compressed air or vacuum. There is no satisfactory method of determining odor pollution except in special cases; for example, ammonia.

FEEL

There is no way of standardizing the feel of air. The personal equation here is quite as large as it is in the case of odors. The feel of a draft which would be highly agreeable and stimulating to one man would cause the next grave dissatisfaction. And yet there must be a something in the feel which cannot be analyzed. It is a sense which should be of great value if we could develop a set of "feelers" who would be the judge and jury. What makes it impossible is the individualism of the feelings. There is a very definite something in the better feel of a sunned and aired bed or the atmosphere which irritates enough to stimulate but not enough to be unpleasant. It is a great pity that such individualism as that displayed by the draft crank makes the feel an unavailable factor in ventilation.

In the present state of public intelligence on ventilation the engineer who invites and stimulates criticism on the basis of the feel is making insurmountable trouble for himself.

There is no instrument or apparatus to measure the feel of ventilation.

VOLUME OF AIR

There is need for a standard of volume of air per inhabitant as a part of a composite standard. As the only standard it has probably been the basis of more so-called ventilation than any other item. Ventilation based on volume alone has not made good—could not be expected to make good. In considering volume variation in the standard is required. As the British Parliamentary Commission have well said: "It is not so much the volume of air which you put in as where and how you put it in." Four cubic feet of air will contain enough oxygen to supply a man's needs for one hour. However, it is impossible to extract all of the oxygen from the air. This would then represent the ultimate theoretical possibility. Seventeen cubic feet of air will furnish enough extractable oxygen for a man for one hour. Let us call this the theoretical possibility. It would supply all that was needed by a calm, cool, idle man if the foul or exhalation air high in CO_2 and in moisture was kept entirely away from the inspired air.

In a given installation the quantity of air needed is in inverse proportion to the separation of these two airs. If we can arrange our inlets and outlets right, and hold our window and wall chill to a minimum, 400 cu. ft. per person per hour would not be far wrong. If we promote mingling of the good and bad air, 2,000 cu. ft. per hour is required. If we make no provision for removal, and have none except through leakage, 10,000 or more cubic feet is required.

Therefore, we can have a standard varying from, say 20 cu. ft. per inhabitant per hour up to 10,000, in proportion as we are able to maintain the head and body of the occupant in a current moving steadily in one direction. The 20 end of the scale is always unattainable. We ought to be able to maintain enough freedom from cross currents to make from 500 to 1,000 proper. Where we try to bring about development of cross currents I have never seen 2,000 suffice.

Therefore I should say in installations where there is intelligent effort to move the air uniformly in one direction, 400 to 1,000 cu. ft. per hour per inhabitant would be sufficient; where diffusion is the principle employed, 2,000 to 3,000 cu. ft. per hour; where leakage is employed, say, 5,000 to 10,000 cu. ft. per hour.

Method: There is not much difference between the wheel and the pressure anemometer. Each is moderately accurate.

CUBIC FEET OF SPACE

A proper standard of ventilation must take into account the cubic feet of space per inhabitant. But this also must be with a proper regard for the other standards. If it is taken as a sole standard it will oftentimes serve to entrench bad ventilation conditions. For example, such a condition prevails in the present factory law of Illinois. Badly ventilated factories which conform to this law are in a better legal position than they were under general police powers.

This standard is of considerable moment in standards of volume of air furnished. If there is a large cubic content of air per inhabitant there must be an increase in the volume of air per hour per inhabitant. In figuring cubic content of air it is necessary to know how much of the product is due to height and how much is due to length and breadth. If the height of a ceiling is 20 ft., obviously the upper 10 ft. of air does not give the same factor of utility as that of the lower 10 ft. The maximum utility comes from the air which is below a point, say, 2 to 4 ft. above the breathing zone.

There should be one standard for rooms with 10 ft. ceilings and another for higher ceilings, say, 10, 20, 30 ft., etc. And, finally, nearly everything depends upon the volume of air furnished. In a street car which is packed to the last floor inch with people there is about 10 cu. ft. of air space per passenger not displaced by the bodies of the passengers or by the

seats and other furniture. This is, of course, an impossible condition of affairs if air is not properly furnished. It is not a markedly deleterious condition in a summer type of car, and it may be made passable by furnishing air flowing at the proper rate and in a uniform direction. In fact, a small cubic feet of space with control of the volume and direction of air represents the maximum economy of use of ventilating air compatible with efficiency.

One thousand cubic feet of air per inhabitant is the usual standard for a 10-ft. ceiling. It should be raised for a higher ceiling. It can be lowered for a lower ceiling. It can also be lowered when there is a guaranteed ventilation efficiency.

AIR CURRENTS

Next to temperature and humidity that which adds most to the discomfort of a room is currents or lack of them. The morguelike stillness of certain places means that there is no force to change the air of the aerial envelope or of the breathing zone except the difference in temperature between the expired air and the surrounding air, and when the room temperature passes 70° F. this force is very slight. On the other hand, the thing which people probably complain of most frequently is a draft.

Ventilation standards will be materially improved if they establish:

First. Unoccupied zones around inlets and outlets.

Second. Temperature of incoming air graded according to occupation of inhabitants.

Third. Rapidity of flow of incoming air.

Fourth. Efforts to control, not to prevent, currents within the room.

I have no standards to suggest.

BACTERIAL STANDARD

A bacterial standard for air is just as desirable as is a bacterial standard for water or for milk. Beyond this suggestion I do not care to go at this time.

Purity of Moisture in Indoor Air

The purity of the moisture contained in the air as well as the moisture itself is a matter that is now attracting increasing attention on the part of heating and ventilating engineers. This phase of the subject was discussed at length by Charles R. Honiball at the recent meeting of the (British) Institution of Heating and Ventilating Engineers. According to an abstract of Mr. Honiball's paper, made by a writer in The Plumber and Journal of Heating, of London, Mr. Honiball stated that in considering the hygrometric condition of the air in rooms enclosed on all sides and its effect on the human system, regard should be given not only to the relative humidity of the vapor in the air, but also to its hygrometric purity compared with the vapor of pure water. A large amount of water is introduced into the air of the room by the respiration of the occupants, the combustion of gas, the vapor of the liquids used in the room, and from other sources in the room. Since vapor from such sources might be regarded as impurities and detrimental to health, it is desirable that the relative amount of such vapor added to every cubic foot of the entering air should be kept as small as possible by efficient ventilation.

The amount of moisture given off by the skin and lungs of a healthy person varies, but taking the amount from the skin and lungs together, it may be assumed to be about 550 grains per hour, enough to raise the relative humidity of the vapor in 380 cu. ft. at 60° F. from 75% to complete saturation, or that in 1900 cu. ft., from 75% to 80%.

With oil as fuel, it is possible to obtain a much higher efficiency from heating boilers than with coal, both with direct steam and hot blast installations. In some tests the figures show from 33⅓% to 50% greater evaporation with oil.—Bert C. Davis *before the Heating Engineers' Society.*

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TWO POINTS brought out in recent discussion of ventilating methods may fairly be called important. One is the apparent unreliability of measuring the purity of air by the amount of carbon dioxide content. The other is the new theory in support of the practice of opening windows on the ground that the human body needs occasional temperature changes in the atmosphere in order to renew the "air envelope" immediately surrounding the body. Even admitting the force of the suggestion in regard to changes in temperature, it will be difficult to convince the ventilating engineer that the proper method of accomplishing this object is through the opening of windows. The chilling effect of inrushing air at winter temperature, to say nothing of the revolutionary effect of the proposition on the present arrangement and operation of heating and ventilating apparatus, will probably be enough of itself to lead to some solution of the matter without retracing the more important steps in the development of present day practice.

"They speak of open windows," was the comment of one prominent engineer, "but they mean an occasional circulation of cool air. This can be accomplished with the present systems as easily and as effectively as by opening the windows."

A DEPLORABLE tendency that seems to be on the increase, in this country, at least, is the practice, which has degenerated into a habit, of "knocking" one's competitor, his business methods, the goods he handles and the men he employs. The habit is not confined to salesmen in the heat of close competition. It has penetrated the heart of the trade itself and comes with a tiresome monotony from the heads of firms down to the minor employees. There is a constant harping on the alleged grave defects of the apparatus or devices of one's nearest competitor which always develops into an endless chain of abuse inevitably leading back to the original link. One of the curious things about this manner of doing business is that the "knocker" seems to be entirely oblivious to the fact that he and his goods are being made the target of the same quality of vilification by the object of his attacks. The better element in the trade is sick and tired of this un-American contagion that has spread like a miasma over its commercial life, even extending to the engineering profession which it has gripped with equally baleful effects.

Pipe Line Design for Central Station Heating*

By B. T. Gifford

The author will endeavor to outline a method he has used in designing central station heating pipe lines as to size and capacity, and give such information and facts as he has found to be reliable, also some curves which he has found to be trustworthy.

It is not the intention to convey the idea that this method is the most perfect, but rather to explain the method with the hope of bringing out a discussion along the lines of this paper.

In the design of a central station heating plant two things must be definitely determined: the location of the central station and the amount and location of the business to be served. The location of the power house should be governed by the location of the territory to be served; also the urgent need of a switch for fuel purposes. In fact, about the same things determine the location of a heating plant as would determine the location of any central station.

The business to be served is in many cases very difficult to ascertain, owing to the uncertain growth of the city, and the fact that it is necessary for financial reasons to have, if possible, every foot of pipe line earning some return on the money invested in it. New buildings will be built and the present buildings may be enlarged, so a great deal of care and thought should be spent on this part of the design.

A method the writer has used for some time with very satisfactory results is as follows: First, prepare a map of the city drawn to scale and of a convenient size to carry in the field; sometimes it is necessary to divide the map into two or more parts. Show on this map all streets and alleys, and the relative elevation of each street intersection. Note also the paved streets and the kind of pavement. On the map show also each building and its location and mark the kind of building, whether business, church, residence, bank, hotel, etc.; together with this the number of feet of radiation it will require to heat each building.

After this information has been secured, make a survey and a careful study of the different sections of the city, noting on the map the best sections for the central heating plant to serve, taking into consideration at all times the future growth of the city. It is in this part of the design that experience is needed, and many times the engineer will find he has made a poor guess. The word guess is used because in many cases central heating plants have grown beyond the wildest dream of its designer.

In a good residence section of homes, owned by people of moderate wealth, 90% of the present business will be connected within five years. Any vacant lots in such a section should be considered as built up with a building to compare favorably with the surrounding buildings.

In a business section 60% to 70% of the available business will be connected within five years. This is greatly dependent upon the kind of heat to be sold, whether steam or water, and whether the buildings are already equipped for heating with steam or water. As a rule, steam service is more popular in business sections, while in residence sections water seems to be more universally sought.

The rapidity with which business is connected to a plant depends upon the company managing the property, but the designer should anticipate a rapid growth in the number of consumers and the amount of business. After having determined the location and amount of business and the central station location, work on the detail design can be started.

Commence by laying in the lines on the map in such a way as to reach the greatest amount of business on the least number of feet of pipe line.

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*Read at the annul meeting of The American Society of Heating and Ventilating Engineers, New York, Jan. 24-26, 1911.

This requires oftentimes the cut-and-try method. Whether to use alleys or streets depends upon two things. First, the relative cost of street and alley construction; second, the location of the buildings relative to the street or alley. The author has found that alley construction, other things being equal, will cost 15% to 30% more for the labor, owing to the difficulty of working in such a narrow space. Another thing affecting the cost of construction is the pavement which has to be taken up and relaid.

In most cities the heating companies are obliged to bring their service pipes to the curb line in the street, and to the property line in the alleys. This item of expense should not be overlooked, for in a wide street the extra cost for service lines will more than eat up the saving in labor effected by street construction.

We will assume for calculation a good residence section, as shown in Fig. 1, Block 2. We can assume that we will get 90% of the available business in this block, which is approximately 10,500 sq. ft. of water radiation, or approximately 6,300 sq. ft. of steam radiation.

We are obliged to allow for future extensions for Block No. 1, and possibly more yet, but in this lay-out we will assume that eventually Block No. 1 will equal Block No. 2. Block No. 2 is 400 ft. long, and Block No. 3 is the same length. We have altogether 21,000 sq. ft. of water radiation to handle, but some of it will be taken off in the first 100 feet, and about 25% of it will be served by the time we reach the center of Block No. 2, 25% more will be taken off by the time we reach B street, and 25% off when we reach the center of Block No. 1. The last 25% by the time we reach the west side of Block No. 1.

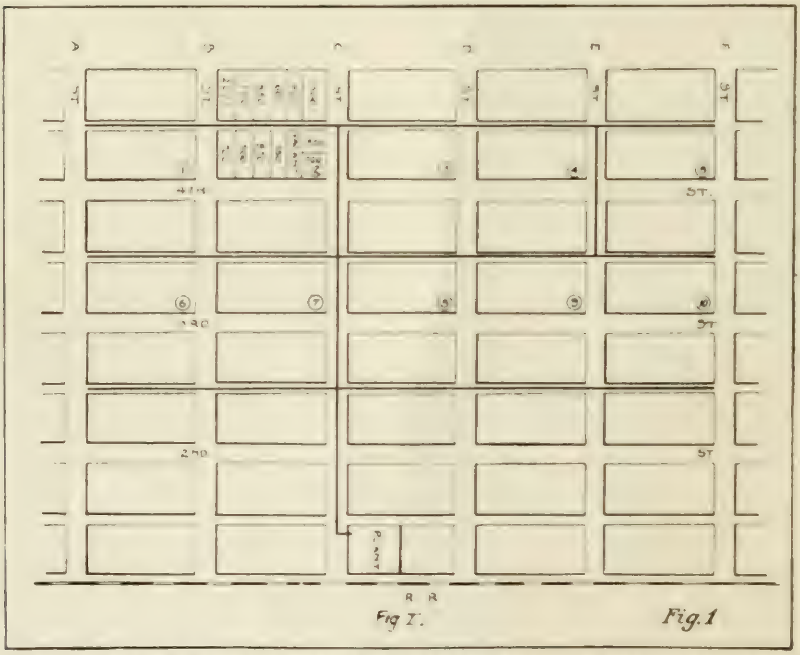


FIG. 1—BLOCK PLAN OF TYPICAL CENTRAL STATION HEATING SYSTEM

MOST OF LINE FRICTION SHOULD BE IN TRUNK LINE

In designing a central station hot-water pipe line the author has found it better practice to throw most of the line friction in the trunk line and to have the friction loss in the laterals very small, and to make the friction loss in the laterals in proportion to

the circulating pressure (difference in pressure) at the point the lateral begins.

As example, we will assume that at the point the lateral for Blocks No. 1 and No. 2 the circulating presure is 5 lbs. Now, we must have at least 1 lb. of circulating pressure at the end of the lateral, therefore we can lose 4 lbs. in friction between the ends of the lateral, or 1 lb. per 200 ft, which is 0.5 lbs. per 100 ft. We then have the following condition:

First 200 ft. of line must handle	21,000 sq. ft. of radiation
Second " " " " " "	15,750 " " " "
Third " " " " " "	10,500 " " " "
Fourth " " " " " "	5,250 " " " "

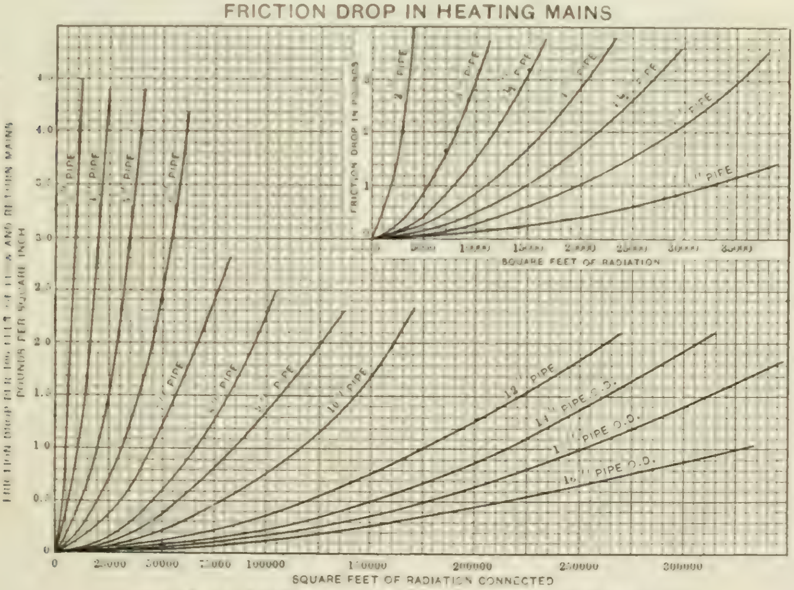
From curve No. 1 we find a 6-in pipe will handle 21,000 sq. ft. with this friction loss, and 5 in. will handle 15,750 sq. ft., a 4½-in. pipe will handle 10,500 sq. ft. with a ½ lb. loss, and a 3½-in. pipe will handle 5,250 sq. ft. of radiation with this friction loss.

sure at the point the branch leaves the lateral as the originating pressure and 1 lb. as the circulating pressure at the end of the branch. Some very interesting problems are found in this work.

The author advocates the use of pipe bends instead of elbows or fittings in the lateral lines.

There has been a practice made use of by some engineers to run a larger return line than flow line; for instance, a 3-in. flow and a 4-in. return line. This method, it is claimed, gives a more equal circulating pressure all over the pipe line system. The author has found that by limiting the heavy friction loss to the main trunk lines that this objection is as equally well overcome and the investment is slightly reduced.

FRICTION DROP IN HEATING MAINS



CURVE 1 - FRICTION DROP IN HOT WATER MAINS

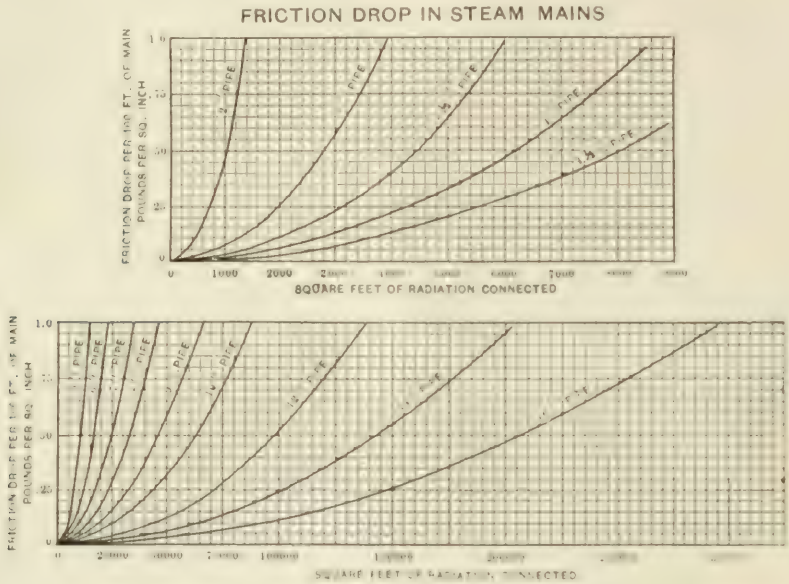
A rule the author has followed is to never run a smaller water main than 3 in. in the initial lay-out; this will always allow for some future extensions.

In figuring a branch line off of a lateral, consider the circulating pressure at the point the branch leaves the lateral as the originating pressure

In designing a central station steam pipe line the same general plan is used. In this case, however, the friction loss is dependent upon the maximum back pressure allowed on the engines if connected as a by-product plant. A live steam central heating

plant should be designed along the same general plan as a hot-water heating system, with 25 lbs. as the maximum pressure on the pipe line. Curve No. 2 shows the curves used for the steam pipe capacities.

Assuming the same territory, viz., will suffice for the last section handling 3,000 sq. ft. As in the case of hot-water heating, there should be a minimum size to install as a main, and in steam heating the author has fixed upon 4 in. as a minimum. The above pipe sizes are figured with the



CURVE II. FRICTION DROP IN STEAM MAINS

Blocks No. 1 and 2, to lay out a steam-heating pipe line. In this case we will also assume that the original pressure where this line begins to be 3 lbs. We will want at least 1 lb. pressure at the end of the line. We can, therefore, lose 2 lbs. in friction. This allows us 0.25 lbs. per 100 ft. In the case of steam pipe line we have the following conditions:

First	200 ft. of line must handle........	12,000 sq. ft. of radiation
Second	" " " " " "	9,000 " " "
Third	" " " " " "	6,000 " " "
Fourth	" " " " " "	3,000 " " "

From curve No. II a 6-in. line will handle 12,000 sq. ft. of radiation, a 5-in. line will handle 9,000 sq. ft., but the fricton loss will be too great (0.54 lbs.), therefore we will continue the 6 in. 100 ft. beyond the first section, viz., 300 ft. in all, and the last 100 ft. we will make 5 in. A 4½-in. line will handle the third section of 6,000 sq. ft. of radiation, and a 4 in.

steam and condensation going in the same direction. If going in opposite direction a greater friction loss will be sustained.

There are, of course, other methods of designing central station pipe lines somewhat more elaborate and a great deal more lengthy, but the method outlined is accurate for any central station lay-out, and has the advantage of beig rapid as well as reliable.

The detail of the construction, such as insulation, method of handling, of expansion, anchors, taps, drainage, etc., will not be considered here, although the capacity of a given sized line is seriously affected by faulty construction, and this point should be carefully considered.

Current Heating and Ventilating Literature

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

CAR HEATING AND VENTILATION.—Recent developments in Car Heating and Ventilation. H. S. William. States requirements and describes a combined heating and ventilating system. 2300 w. El Ry Jl—Dec 3, 1910. 20c.

ECONOMICS. — Central-Station Heating to Conserve the Natural Resources. F. H. Stevens. Explains advantages and economy of central-station heating. 1500 w. Elec Wld—Dec 8, 1910. 20c.

HEATING REQUIREMENTS. — Estimating Heating Requirements. Reginald P. Bolton. Excerpt from a paper read before the Assn. of Edison Ill. Co.'s. Presents a method including the loss by infiltration. 2500 w. Power—Dec 27, 1910. 20c.

HOT-WATER PIPING.—Corrosion of Hot-Water Piping in Bath-Houses. Ira H. Woolson. Reports results of investigations made. 1800 w. Eng News—Dec. 8, 1910. 20c.

SHOP VENTILATION.—The Determination of Impurities in factory Air (L'Aria degli Ambienti Industriali e le Misurazioni degli Inquinamenti). Discusses particularly the researches of Henriet. 2000 w. Monit Tech—Oct. 30, 1910. 40c.

VENTILATION.—The Air We Breathe. William E. Watt. Discusses how vitality comes from the air and what deteriorates it. 2500 w. Dom Engng—Dec. 17, 1910. 20c.

The Vicious Quantitive Standard in Ventilation. William Henry Lynch. A discusson of the limit of present knowledge of ventilation, arguing that any standardization at the present time would be standardizing ignorance. 4500 w. Dom Engng—Dec. 17, 1910. 20 c.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Headquarters of the Society Now Located in Engineering Societies Building

Announcement is made by Secretary W. W. Macon that the headquarters of The American Society of Heating and Ventilating Engineers are now located in the Engineering Societies Building, 29 West 39th street, New York, the 13-story building devoted wholly to housing engineering societies. Quarters have been secured on the eighth floor and, by virtue of the fact that the society is now one of the associated engineering societies, certain privileges offered by the building are available to members of the society. For the present office hours will be from 9 a. m. to 5 p. m.

American Institute of Chemical Engineers

The third semi-annual meeting of the American Society of Chemical Engineers will be held in Chicago, June 21-24, 1911. A feature of the meeting will be the report of a committee on Standardization of Boiler Tests.

National District Heating Association

Arrangements are going forward for the third annual convention of the National District Heating Association which will be held in Pittsburg, Pa., June 6, 7 and 8, 1911, with headquarters at the Fort Pitt Hotel. Special rates have been offered by this hotel and the professional sessions will be held in the banquet hall. Provision will also be made for exhibits.

The subjects on the programme, so far as announced, are as follows:

Radiators and their treatment.

Report of the committee on data, which will include rates and other data pertaining to the heating business.

Report of committee on meters.

Report of the committee on radiation.

Results of measuring station load by the Venturi and General Electric Meters.

Heating franchises.

This will be in addition to five papers, the subjects of which will be announced later.

Entertainment on a large scale will be provided for both members and guests, including the ladies, by the manufacturers and other members in Pittsburg. The convention follows that of the National Electric Light Convention which will be held in New York, and it is anticipated that many of the western members who attend the New York convention will return by way of Pittsburg so as to take in that of the district heating engineers.

Business Changes

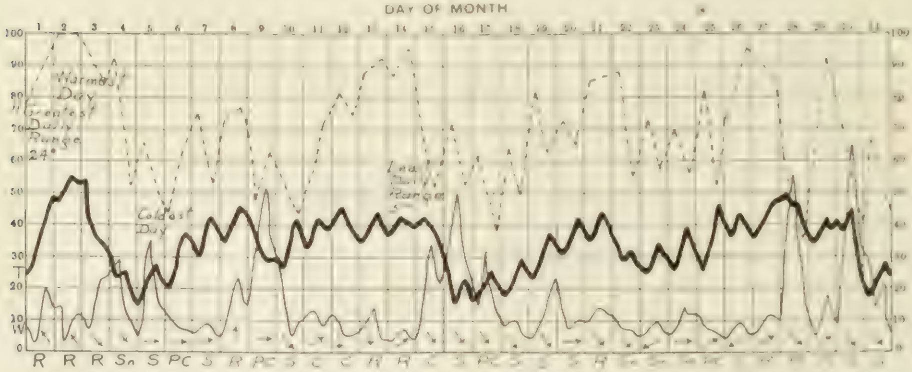
Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following-named work:

Until January 21, 1911, for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the U. S. Post Office and Court House at Bowling Green, Ky.

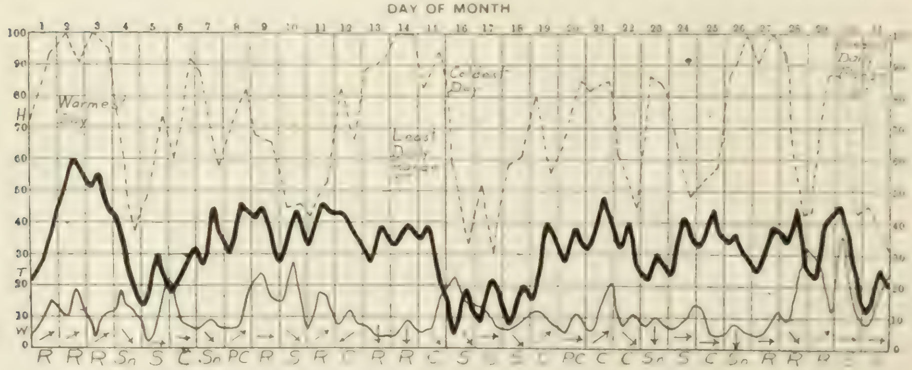
Until February 3, 1911, for the extension, remodeling, etc., including plumbing, gas piping, heating apparatus, and electric conduits and wiring system, of the U. S. Post Office and Court House at Salt Lake City, Utah.

The Weather for January, 1911

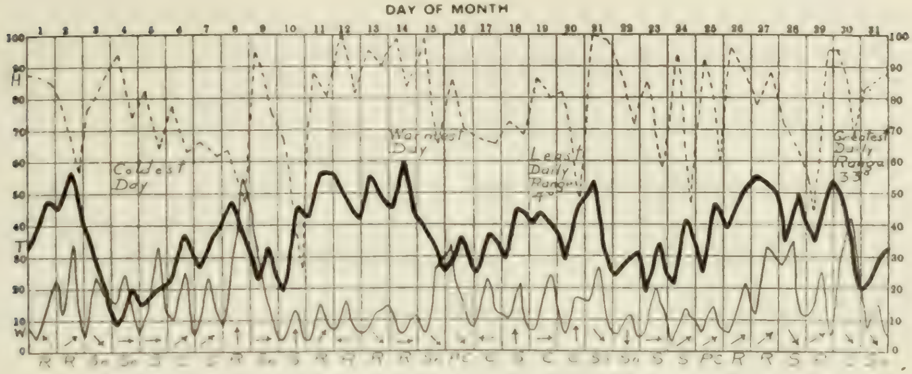
	New York	Boston	Pittsburg	Chicago	St. Louis
Highest temperature, degrees F........	54	60	60	54	74
Date of highest temperature...........	2	2	14	26	11
Lowest temperature, degrees F........	15	4	9	0	—2
Date of lowest temperature..........	5	16	4	5	[illegible]
Greatest daily range, degrees F......	24	30	33	34	46
Date of greatest daily range...........	1	30	30	2	11
Least daily range, degrees F...........	5	5	4	2	6
Date of least daily range..............	14	14	19	17	17
Mean temperature for month, degrees F.	35	32	35	29	36
Normal mean temp. for this month, dg. F	30.8	28	30.7	23.7	32
Total rainfall, inches..................	2.27	2.28	3.36	1.17	0.85
Total snowfall, inches................	1.1	0.7	7.7	2.2	0.5
Normal precipitation, this month, inches	3.79	3.71	2.87	2 [illegible]	2.36
Total wind movement, miles..........	9414	8164	8503	11710	8814
Average hourly wind velocity, miles..	12.7	11	11.5	15.7	11.8
Prevailing direction of wind...........	N. W.	West	N. W.	South	South
Number of clear days.................	6	8	7	3	8
Number of partly cloudy days.........	11	6	3	7	[illegible]
Number of cloudy days...............	14	17	21	21	14
Number of days on which rain fell.....	15	17	16	12	7
Number of days on which snow fell....	2	3	7	4	3
Snow on ground at end of month, inches	None	None	0.8	Trace	None



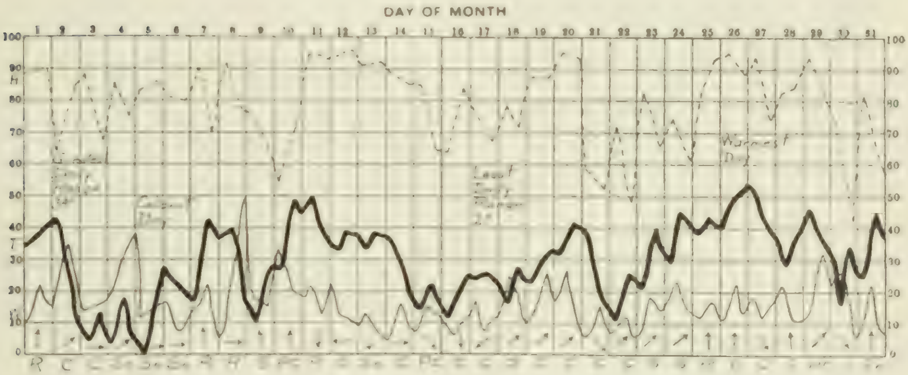
RECORD OF THE WEATHER IN NEW YORK FOR JANUARY, 1911



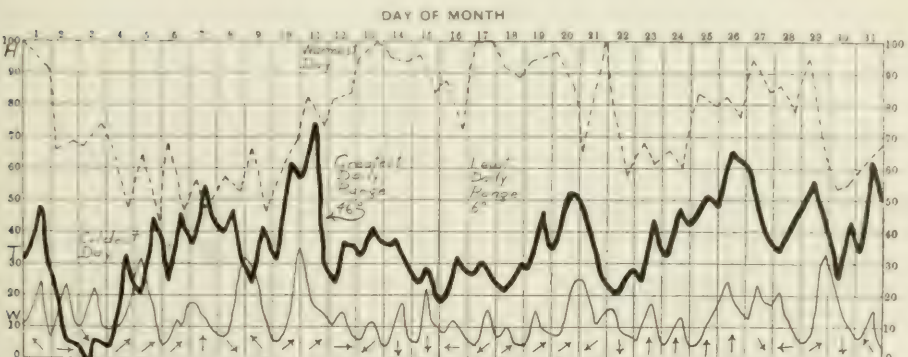
RECORD OF THE WEATHER IN BOSTON FOR JANUARY, 1911



RECORD OF THE WEATHER IN PITTSBURG FOR JANUARY, 1911



RECORD OF THE WEATHER IN CHICAGO FOR JANUARY, 1911



RECORD OF THE WEATHER IN ST. LOUIS FOR JANUARY, 1911

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate relative humidity in percentage from readings taken at 8 A.M. and 8 P.M.
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—Snow.
Arrows fly with prevailing direction of wind.

An Extensive Heating System

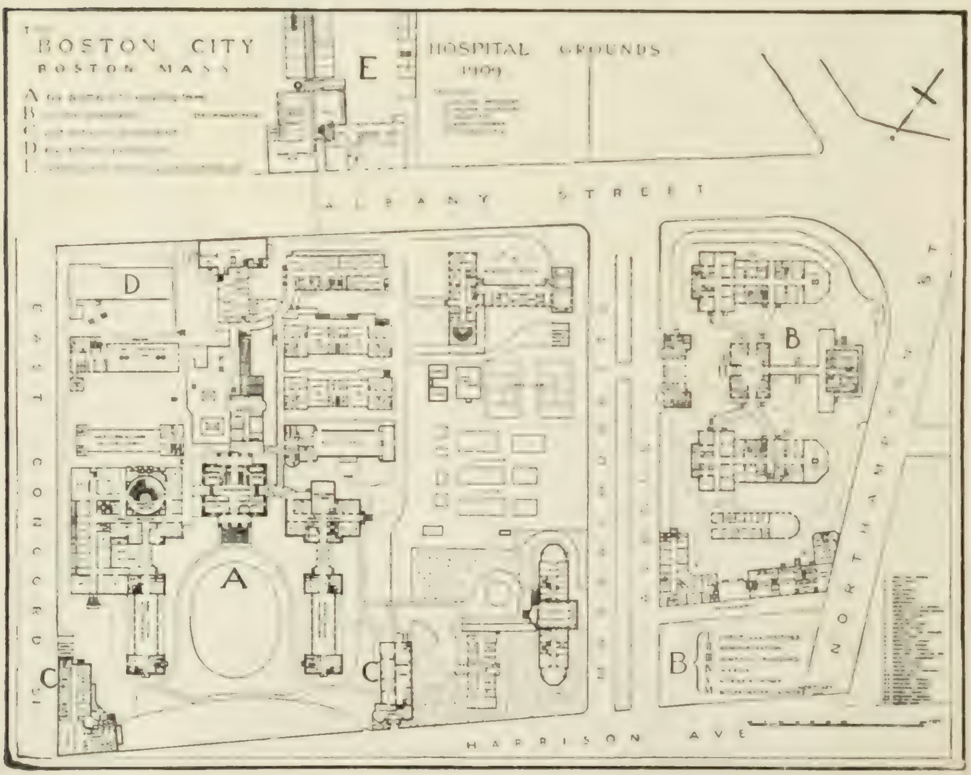
The heating system of the Boston City Hospital is remarkable, among other things, for the unusual extent of the property heated from one boiler room and the extreme lengths of pipe necessary in consequence

To give some idea of the size of this installation it need only be said that there are 26 separate buildings to be heated, occupying an area approximately 640 ft. by 1,000 ft. In the design of this installation, one of the absolute requirements was the location of the power plant outside the hospital grounds in order to assure a maximum of quiet and cleanliness. This, of course, added to the difficulties of the situation, necessitating as it did much longer pipe lines than would have been necessary had it been possible to place the boiler plant in a central position with reference to the buildings of the hospital. The longest heating main is over 1,100 ft. in length, while two others are 900 and 1,000 ft. long, respectively.

In order to insure positive circulation a Webster vacuum system was installed, the returns leading to three vacuum pumps situated in the boiler house.

Very often in the case of a group of scattered buildings operated on a vacuum system the nearest buildings to the vacuum pump have a great deal better circulation than the more remote. In order to avoid such a condition in this installation each building has been equipped with an automatic regulating device known as the Webster "Type D" apparatus, which may be set at any desired point and by this means maintain a constant degree of vacuum at that building. This apparatus consists of a diaphragm vacuum controller which regulates the degree of vacuum and through which the air is discharged, and a trap which discharges the condensation of the building to the main return line.

This particular heating system seems noteworthy in view of the extreme conditions which it had to meet and its success in coping with them. Not only was it necessary to supply steam to some 1,700 heating units situated at widely differing distances from the boilers, but positive circulation had to be obtained throughout the system with a minimum of noise or other disturbances. This has been satisfactorily accomplished and not the least important feature of this system's operation has been the entire absence of water hammer. The entire

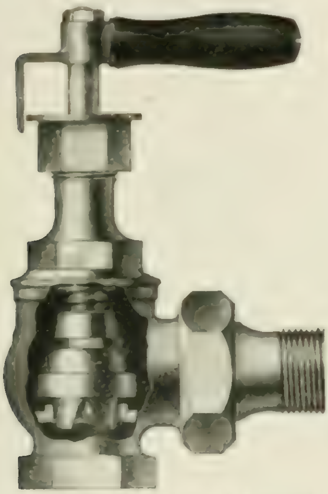


BLOCK PLAN OF THE BOSTON CITY HOSPITAL, BOSTON, MASS

work was in charge of the engineering firm of Densmore & LeClear of Boston, Mass.

A Unique Type of Fractional Radiator Valves

Among the the many interesting types of graduated radiator valves which have recently appeared on the market, one of the most unique is the Jenkins Bros. Standard fractional radiator valve, for use in connection with street steam systems, atmospheric systems, vacuum return line systems and vapor systems. The point is made that the problem of partly heating a radiator so that with a



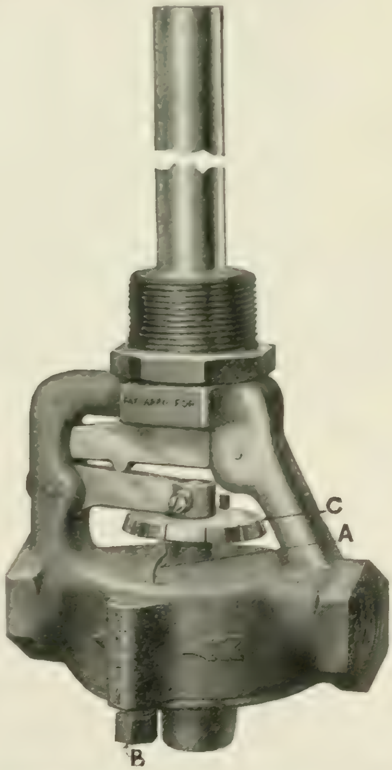
JENKINS STANDARD FRACTIONAL RADIATOR VALVE

constant pressure of steam, the temperature of the room may be changed at will to meet varying external temperatures, or to suit the requirements of the occupant, can be solved more satisfactorily by restricting the inlet to the radiator than in any other practical way.

The selective or fractional heating has reached such a satisfactory stage with so many systems of circulation that the use of this type of valve is becoming increasingly popular on all such systems. In the case of the Standard fractional or restricting inlet valve, which is shown in the accompanying illustration, emphasis is laid on the correctly graduated opening so that the partial heating of the radiator is at all times under the easy control of the operator. The restricting orifices are so shaped that the wear due to wire drawing effect of steam at high velocity is uniform and so located that it will not cut the disk or seat and thus cause the valve to leak. The valve is fitted with the Jenkins disk and is of Jenkins Bros. standard of design, material and workmanship.

The capacity of these valves in feet of direct radiation, with steam pressures from ¼ to ½ lb is as follows: ½-in. will take care of anything up to 20 sq. ft. of radiation, ¾ in., from 20 to 40 sq. ft.; 1-in., from 40 to 80 sq. ft.; 1¼-in., from 80 to 160 sq. ft. and 1½-in., from 160 to 320 sq. ft.

Robertshaw Thermo Valves, for steam or hot water house heaters (gas fuel), steam heated tanks and gas water heaters, is a new publication describing a reliable and inexpensive thermostat for use on steam and hot water heating systems. The device is made by the House Service Utilities Mfg. Co., Pittsburg, Pa. On steam heating systems it is stated that the valve can be regulated to maintain an even pressure at all times, and on hot water system a con-

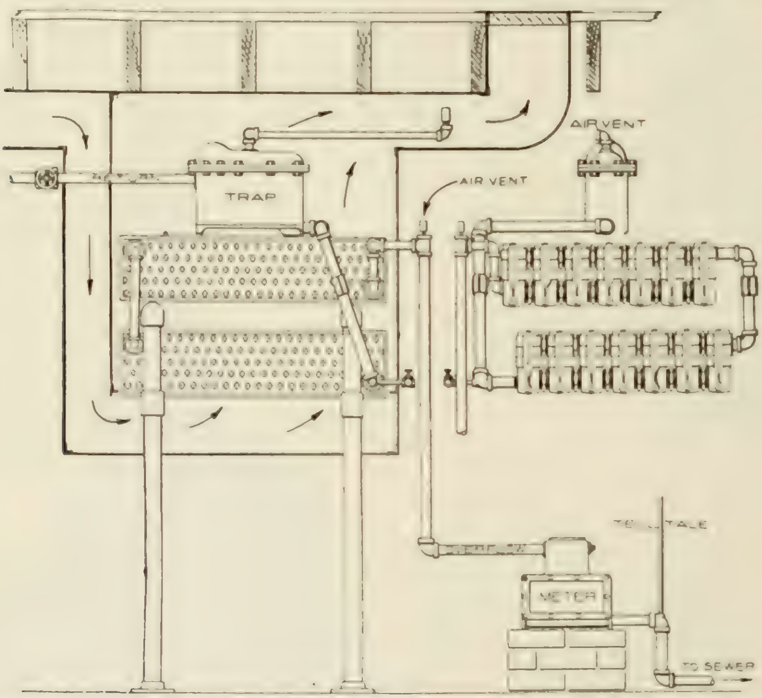


ROBERTSHAW THERMO VALVE FOR USE WITH BOILERS USING GAS FUEL

stant temperature of the water. The Robertshaw thermo valve shuts off directly against the gas. In a steam heating system the thermo is placed in the riser or return pipe so that the copper tube, which is a part of the valve, is in the flow of steam. The gas

is run through the valve to the burner. When set for any desired pressure, the valve automatically shuts off the gas when this pressure is reached and opens when the pressure commences to diminish. A safety valve is unnecessary as there is no blowing off and no water to be replaced. The same thermo is used on hot water systems and has a dial regulation that makes the valve easily adjustable to any desired temperature. The valve can be placed in the riser return, or in the tank or boiler.

Hospital Ventilation is the title of special circular published by the McCreery Engineering Co., Detroit, Mich. Among the subjects covered are the limitations of ventilation, over-dryness of air and its result, and cool air for patients. The publication calls attention to the fact that the Vento cast-iron heater was first placed on the market in 1905 and has withstood the test of the most exacting conditions. Vento heaters, it is stated, are in successful operation in some cases where the entering air passing the stacks is as low as 30° F. below zero. The engineering data contained in the catalogue, in addition to the data directly referring to the Vento heater, include constants for heat transmission through various building materials, temperature and condensation charts under various conditions of operation, arrangement of heater for central station heating, various air tables, equalization of pipe diameters, together with pipe and steam tables. The work is profusely illustrated, a number of pages being devoted to



SIDE AND END VIEWS OF VENTO COILS USED ON AN "ECONOMIZING COIL" IN CENTRAL STATION STEAM HEATING, LOCATED IN BASEMENT AT RETURN END OF STEAM MAIN

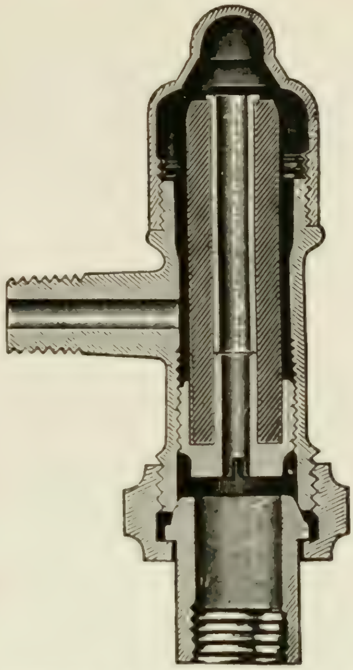
adaptability of the McCreery air purifier and humidifier for hospital work is gone into at length.

Vento Cast-Iron Hot Blast Heater, for heating, ventilating, drying and cooling, is a new publication issued by the American Radiator Co., Chicago, which, in addition to covering in detail this form of heater, presents charts and other matter of an engineering character that should prove most useful to designing as well as contracting engineers. The photographic reproductions of typical installations. Size 8 x 10¾ in. Pp. 56.

The Webster Air Washer is the title of what is probably the most exhaustive treatise on the modern air washer and the conditioning of air that has yet appeared. As showing the deep study that has been given to this subject, mention is made of the work of the air conditioning department of Warren Webster & Co., in charge of William G. R. Braemer, which has been conducting tests in a spe-

cial testing plant erected at the company's factory in Camden, N. J., since before the first Webster air washer was marketed. This plant has an experimental equipment which makes it possible to produce artificial atmospheric conditions at will. The result is an unusual knowledge of the subject, including a large amount of valuable and original engineering data, much of which is contained in the present catalogue. The publication is profusely illustrated, showing the air washer in various stages of construction, also detail views of the apparatus and typical installations. A most interesting chapter is devoted to the Webster air washer as a cooling medium. This matter is accompanied by charts which have added value as being the results of numerous experiments. The catalogue concludes with views of prominent buildings equipped with Webster air washers, followed by fac-simile testimonials showing the successful operation of this apparatus. Pp. 116. Size 6 x 9 in. (standard).

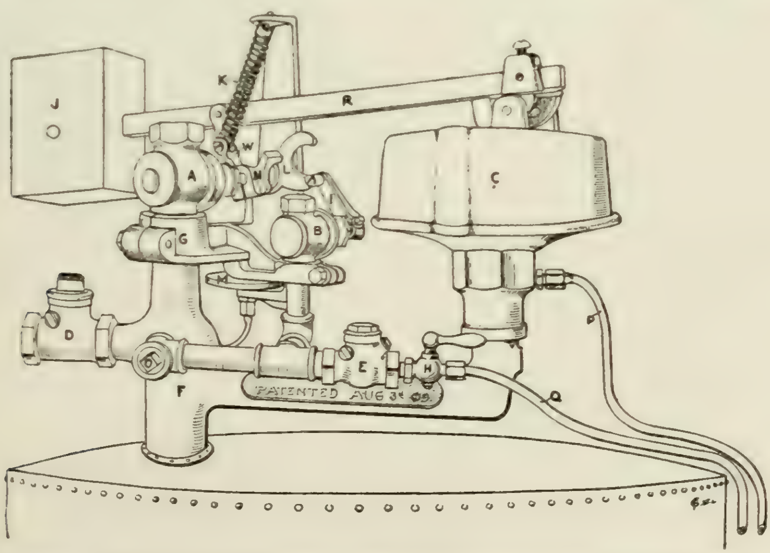
Sparks System of Positive Steam Circulation, using the Sparks automatic vacuum pump, is a new publication issued by the Automatic Vacuum Pump Co., St. Louis, Mo. The Sparks vacuum pump, it is stated, really pulls the cold air from the system, and does not operate the valves. It is said to be the only system that can be applied successfully to old as well as new one-pipe (with air line) heating systems, even where the old system is not air-tight. The vacuum pumps are made in sizes to suit all heating plants from those with 500 sq. ft. or less radiation up to the largest installations. The operation of the Sparks system may be noted by referring to the illustrations.



SECTION OF VALVE USED WITH SPARKS VACUUM HEATING SYSTEM

Atmospheric steam enters the tank through the normally open valve A; discharges air and any water contained in the tank through check valve (2).

After steam has filled tank, it will flow out through (2), and up into



GENERAL VIEW OF VALVE MECHANISM, SPARKS VACUUM HEATING SYSTEM

thermostat (1), passing out through holes at top (4). As it passes up through the thermostat it heats the volatile fluid contained therein, causing it to expand up into C; this operates lever R.

The action of lever R closes steam valve A and opens water valve B. This admits a spray of water into tank, and also into the thermostat—this water causes the steam in tank to condense immediately, forming a vacuum (in tank) equal to the volume of tank; it also cools off the thermostat, permitting lever R to drop and close the water valve B.

The vacuum thus formed continues to act on the air line (through D) until a full tank of air is pulled out from the system.

Now lever R continues to fall, compressing spring K. When R reaches bottom, spring K passes center, and opens steam valve A instantly; and begins a fresh stroke, by discharging air in tank into the atmosphere, and again filling the tank with steam. Check valve D prevents either steam or air passing back into air line.

After the pump has removed all the air from system through the air line, the vacuum on system thus created pulls the steam into every radiator and pipe without pressure from the boiler.

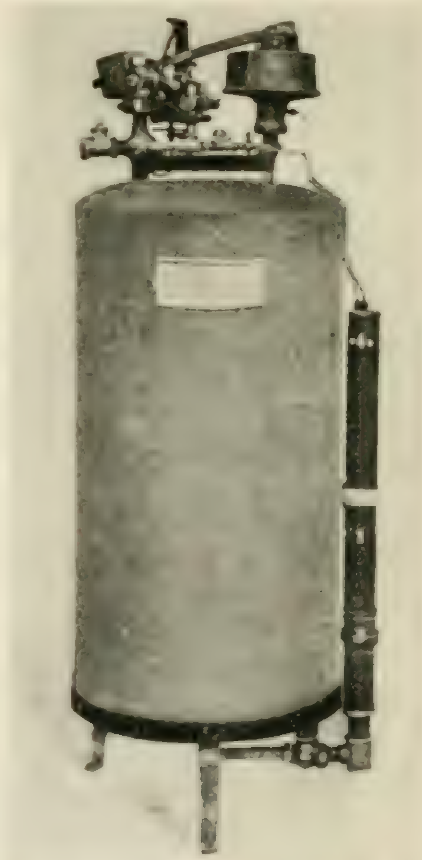
When this condition is reached there is no need for continuing action of the pump. The vacuum we have produced is now used to lock valve mechanism, and prevent acting of the pump. This is accomplished by the vacuum compressing diaphragm M, and causing bell-crank U to catch lever L, after it has closed water valve B and before it opens steam valve A—both valves are thus closed; using neither steam nor water.

As long as vacuum on system continues pump will not act. As soon as the vacuum drops below tension of spring S, lever U unlocks, and the fall of lever L opens steam valve and starts pump in operation. Pump working only when required, to keep system clear from air.

A New Data Book on Fans and Blowers

Fans and Blowers is the title of an unusual compendium of data lately issued by the Ilg Electric Ventilating Co., Chicago, Ill., and covering, in addition to mechanical data, tables, etc., on blowers, volume blowers, forge blowers, portable ventilating sets, propeller fans and automatic shutters. The book is loosely bound so that the sheets may be taken out for reference. The mechanical data alone includes sizes of flues for given air volumes, diameters of pipes for given air volumes and velocities, areas of circles, etc.; volume and density of air at various temperatures, moisture in the atmosphere, tables of air pressure and velocity, weights of galvanized iron, hygrometric chart, properties of air, flow of air in pipes, weight and thickness of sheet metal, prices of galvanized iron and elbows and a curve of pressures and velocity.

The publication is arranged with a degree of care that should make it a most useful handbook for the estimating and drafting room. We understand it can be obtained without cost for the asking. The company may be addressed either through its Chicago or New York



TANK AND VALVE MECHANISM SPARKS VACUUM SYSTEM

offices, the New York address being 145 Chambers street. Pp. 72 (printed on one side only). Size 9¼ x 5¼ in.

New Humidity Regulating Device

Warren Webster & Company, Camden, N. J., have recently been granted Patent No. 977,933 covering a humidity regulator, which is expected to occupy an important position in the future development of the art of humidity control.

TRADE AND MISCELLANEOUS NOTES

Coming Events

June 6-8, 1911. Third annual convention of the National District Heating association at Pittsburg, Pa. Headquarters will be at the Fort Pitt Hotel.

June 13-15, 1911. Annual convention of the National Association of Master Plumbers, Galveston, Texas. Headquarters at the Hotel Galvez.

Deaths

W. B. Dickson, president of the W. D. Dickson Plumbing, Heating & Roofing Co., Peoria, Ill., died Jan 21, 1911, at his home in Peoria. He was 63 years old. He left and estate valued at $300,000.

Miscellaneous Notes

Otto E. Goldschmidt, New York, consulting engineer for mechanical, electrical and sanitary engineering of buildings, has removed his office from the Singer Building to 30 West 38th street, New York. Mr. Goldschmidt has been associated with Charles G. Armstrong, of New York. He is at present consulting engineer for the Aeolian Company and is designing the mechanical equipment for a new 10-story hotel in Atlanta, Ga.; Schenectady County (N. Y.) Court House and other structures.

Wisconsin Federation of Labor, through its executive board, has framed a number of important bills which have been presented to the State Legislature, including one requiring that all factories and mercantile establishments be provided with modern systems of ventilation.

Ann Arbor, Mich. The request of the regents of the University of Michigan for an appropriation to build a new heating plant will be presented to the legislature probably before the close of the present session. The new pant will cost about $200,000. At present the boilers are running up to their full capacity all the time and the electrical

pant is so overtaxed that it is a standing rule on the campus that all power machines must stop when the lights are turned on at 4 o'clock in the afternoon.

Chicago, Ill.—A "thermometer regiment" consisting of 1,204 Chicago women, has been organized by the Woman's City Club of Chicago, to undertake a ventilating crusade. The first step in the warfare for better air will be a careful inspection, with thermometers and notebooks, of the street cars of Chicago.

Kokomo, Ind.—Plans are well under way for the construction of the new central heating plant in Kokomo, which will be built by the Public Utility Co. of that place.

Anderson, Ill. A plan is being formulated whereby the Central Station Engineering Co., of Chicago, will take over the plant of the Home Heating Co., of Anderson, including its franchises, and install a new plant enlarging the territory for steam heat.

United Bunch of Sheep, New York Fold, at a meeting held January 27, elected the following officers: Grand ram, O. Chan Wells; vice-ram, William Murray; past grand ram, Thos. H. Hutchinson; keeper of the golden fleece, Henry Stein; shearer, J. W. Gannon; herder, J. S. Thomas. The organization, which is made of salesmen in the heating and plumbing trades, reports a rapid increase in membership.

Greater New York Building Trades Council has issued its schedule of the prevailing rates of wages for 1911. The schedule is based on 8 hours work per day, Saturday half-holiday, and double pay on Sundays and legal holidays and afternoon on Saturdays. The schedule includes the following: plumbers, gas fitters and steam and hot water fitters, $5.50 per day; asbestos workers, boiler felters, insulators and pipe coverers and stationary engineers, $4.50 per day; asbestos workers' helpers, $2.80 per day; steam fitters' helpers, $3.00 per day.

Harrisburg, Pa.—Harrisburg Association of Master Steam and Hot Water Fitters, has been organized as a local association of the national body. President, William Jennings; vice-president, C. Fisher; treasurer, Warren Bossler; secretary, H. B. Low.

Defiance, O.—Defiance Gas and Electric Co., has asked the city council to revive the matter of the application for a franchise to permit the laying of steam heating mains through several of the city streets to furnish steam heat in the shape of exhaust steam from the company's power plant. The work will cost between $25,000 and $30,000.

Milwaukee, Wis.—Complaints of the bad odors in the ventilation of the Sixteenth District School, at Eighteenth and Prairie streets, led to an investigation which disclosed the fact that the fresh-air chamber was situated directly over a sewer-catch basin which contained no trap and was without a cover.

Fort Wayne, Ind.—A franchise for a central station heating system in Fort Wayne, which will cover the downtown district, is being sought by an organization which includes John F. McCarthy, of Chicago; J. E. McCarthy, of Peru, and Henry B. Monning, of Fort Wayne.

Washington, D. C.—A central heating plant, for the use of three of the largest schools in Washington, will be built during the next few months. Bids for the work have already been advertised by Snowden Ashford, municipal architect. The new plant will supply the M. Street High School, the Simmons and Douglass Schools, all of which are in the block bounded by M Street, First Street and New Jersey Avenue.

Manufacturers' Library, Hudson Terminal, 50 Church street, New York, consisting of a free reading-room, with reference catalogues, a club-house with all the accessories of telephones, stenographers and private rooms for business appointments, has been established under the auspices of the Commercial Bureau Co., of New York. The library is designed to keep on file a complete classified list of catalogues of American manufacturers. The total cost to the manufacturer is $10.00 per year.

International Institute of Technical Bibliography, 57-58 Chancery Lane, London, W. C., has completed its first volume which, it may be stated, is probably the most complete technical index yet published. It is stated that more than 100,000 books and articles are abstracted or indexed annually covering the technical press and learned societies of the world, generous space being given to American articles. The indexing of the articles, etc., is divided into seven sections, the Section 1 being devoted exclusively to mechanical engineering. This section is known as "Engineering Abstracts, Section 1" and is published monthly. The subscription price is 24 shillings ($5.76) per annum, post free.

International Municipal Congress and Exposition, which is being planned to be held in Chicago September 18-30, 1911, in the Coliseum, Armory and Exposition Grounds, has named John Mac-

Vicar as commissioner-general of the exposition. Mr. MacVicar is secretary of the League of American Municipalities. He is also superintendent of streets and public improvements in Des Moines, Ia., a city which has attracted much attention lately because of its advanced form of government.

Manufacturers' Notes

Gurney Heater Mfg. Co., Boston, Mass., announces that it is in a position to make immediate shipments of any size boiler, either hot water or steam, also tank heaters. When the company's new plant at Chelsea is completed in the spring, it will be the most complete of its kind in the country.

Alberger Pump Co., 140 Cedar street, New York, announces that the contract recently closed with the United States Navy Department, covering eleven 54-in. and seven 15-in. vertical shaft centrifugal pumps, with complete electrical equipments, for the New York, Puget Sound and Pearl Harbor dry docks, will in no way impair its facilities or capacity for turning out in good time all of its normal business.

United States Radiator Corporation, Detroit, Mich., announces the appointment of George W. Barr as manager of its Philadelphia office. Mr. Barr has been for many years manager of the boiler department of Isaac A. Shepard & Co., Philadelphia.

National Radiator, Co., Johnstown, Pa., has purchased the plant and property of the Oliphant Steel & Iron Co., at Trenton, N. J., where radiators will be manufactured for supplying the eastern trade. The new plant, when improvements are completed, will employ about 400 men. The present plant at Johnstown will be devoted hereafter to supplying the western trade.

H. Mueller Mfg. Co., Decatur, Ill., held a ten-day convention of its salesmen recently. The company reports the past year to be the largest in its history.

Ingersoll-Rand Co., New York, has acquired a controlling interest in the A. S. Cameron Steam Pump Works, New York. There will be no change in policy or management.

Hart & Crouse Co., Utica, N. Y., announces an increase in its capital stock from $226,000 to $650,000.

United States Radiator Corporation, at its first meeting in 1911, elected Detroit as the permanent headquarters of the corporation. The removal from the temporary headquarters in Dunkirk, N. Y., will be made within two or three months. A semi-annual dividend was declared of 3½% on the preferred stock for the half year ending Dec. 31, 1910. The stock was put on a quarterly dividend-paying basis and a dividend declared for the quarter ending March 31.

Bay State Brass Co.'s plant at Haydenville, Mass., was sold at public auction, to H. J. B. Willis, of New York, representing other creditors in addition to himself, for $22,700. It is stated that

the plant will be put in operation in a short time

Federal-Huber Co., Chicago, announces that the receivership which has had charge of the company's affairs for the purpose of settling differences between stockholders, has now been removed. The capital stock of the company has been increased from $500,000 to $640,000, the present stockholders having taken over that of the dissatisfied stockholders.

Ideal Heating and Ventilating Co., Columbus, O., manufacturer of gas furnaces and fittings, has increased its capital stock from $10,000 to $25,000

New York Blower Co., Bucyrus, O., announces the removal of its eastern office from Philadelphia to St. Johnsville, N. Y., on the main line of the New York Central Railroad, about 64 miles west of Albany. The office will continue in charge of Emil A. Briner.

Central Foundry Co., New York, manufacturer of soil pipe and fittings, etc., which has been for some time in the hands of a receiver, is being reorganized by a committee representing the debenture bondholders. It is planned to reduce the capital to one-half that of the previous capitalization. Through assessments on the preferred and common stockholders it is planned to secure $1,000,000 fresh capital which will pay the secured debt of the company, the floating debt of its subsidiaries and provide for improvements.

New Incorporations

Morgan County Heat and Fuel Co., West Liberty, Ky., amended articles, fixing the highest amount of indebtedness at $50,000.

Ohio Valley Heater Co., Cincinnati, O., capital $10,000. Incorporators: Guy S. Cornish and others.

Perfection Heating and Purifier Co., Milwaukee, Wis., capital $10,000. Incorporators: T. Ward, A. E. Ward and Henry A. Kirch.

Marsh Valve Co., Dunkirk, N. Y., capital $250,000, to manufacture a line of valves, especialy a quick-opening, double-seal radiator valve. Incorporators: W. C. Marsh, N. F. Gould and F. J. Reed.

Caloridon Heat and Improvement Co., St. Louis, Mo., capital $5,000, to manufacture a device known as a Caloridon to supply air through a chimney flue to the top of a fire. In this manner heat and gases, which ordinarily go to waste up the chimney, are made to do useful work in the combustion chamber itself. President and general manager, Charles Gaa; secretary, Joseph Gaa.

Oscar G. Thomas Co., Taunton, Mass., capital $50,000, to manufacture heating specialties. Incorporators: Oscar G. Thomas, president and treasurer; R. W. Whitmarsh and H. W. Thomas.

Downey Heating & Supply Co., Milwaukee, Wis., incorporated to take over the business of the Downey & Kruse Co., and of the H. Mooers Co., both of Milwaukee. The headquarters of the new company are located at 613-615 Clybourn St., Wm. K. Downey, in charge. The firm will continue a contracting business in heating and ventilating work.

Ozone Co., Cleveland, O., capital $10,000, to manufacture electric air purifying devices. Incorporators: P. D. Metzgar, R. D. Williamson, P. C. Stoller, F. L. Kechler and Robert H. McKay.

D. M. Marshall Co., Oakland, Cal., capital $50,000, to conduct a hardware and heating and plumbing business. President, C. Marshall, No. Anson; treasurer, D. M. Marshall, Oakland.

Force Valve and Brass Manufacturing Co., St. Louis, Mo., capital $50,000. Incorporators: Clarence E. Anglin, William J. Gates and G. Howard Willett.

Scott & Co., Wilmington, Del., capital $100,000, to conduct a heating contracting business. Incorporators: David E. Rattan and Oliver E. Solomon, Philadelphia, and James Lord, Dover.

Water Power Vacuum Cleaning Co., Buffalo, N. Y., capital $50,000, to manufacture a vacuum cleaning apparatus. President C. C. Trow; treasurer, H. C. Redfern; secretary, J. P. Clifton. Quarters have been secured at 730 Main street.

Muncie Regulator Co., Muncie, Ind., capital $25,000, to manufacture temperature regulating devices. Directors: W. O. Haymond, J. O. Potter and W. T. Haymond.

Heating and Ventilating Engineers' Association of Indianapolis, Ind., incorporated for the advancement of the heating trade in all its latest discoveries of science. Incorporators: A. H. Turner, R. Hawkins, H. Rybolt and James P. Carroll.

Brunelle Boiler Co., Worcester, Mass., to manufacture and deal in heating apparatus. Capital stock, $25,000. President, F. X. Brunelle; treasurer, J. A. Gervais, both of Worcester.

W. A. Nairn, Jersey City, N. J., capital, $50,000, to deal in plumbing, heating and sanitary fixtures and supplies. Incorporators: Walter A. Nairn, 642 Montgomery street; William Reilly and Roy S. Tinney, all of Jersey City.

T. Oakes & Son, Hartford, Conn., capital $50,000, to conduct a general heating and plumbing business. Incorpora-

tors: Thomas Oakes and William E. Oakes, of Hartford, and J. Albert Oakes, of Windsor.

W. A. Birdsall & Co., 74 Mechanic street, Newark, N. J., organized to conduct a jobbing business in boilers, radiators, vacuum cleaners and heating specialties. Mr. Birdsall was formerly with the Model Heating Co., which was recently absorbed by the McCrum-Howell Co.

Valve Brass Mfg. Co., St. Louis, Mo., capital $50,000. Incorporators: Clarence E. Anglen, William G. Gates and G. Howard Willett.

Reliance Wrench Mfg. Co., 1508 State street, Racine, Wis., capital $25,000, to manufacture wrenches.

Halley Heating & Mfg. Co. Boone, Ia., capital $10,000. Incorporators: H. D. Howe, V. O. Holcombe and E. A. Reichenbach.

Dickerson Mfg. & Supply Co., Clinton, Ill., capital $200,000, to manufacture a water gauge for steam boilers of all kinds, invented by Charles L. Dickerson, president. The location of a plant is under consideration.

Western Heating Co., San Francisco, Cal., capital $25,000. Incorporators: R. V. Whiting, F. L. Stewart, L. F., J. F. and A. H. Malloran.

B. F. Dockey Jointless Water Pipe C.o, Los Angeles, Cal., capital $25,000. Incorporators: B. F. Dockey, L. W. Bentz, J. H. Carr, G. H. Norton and W. C. Wilson.

Logan Ventilating Window Co., St. Louis, Mo., capital $2,000. Incorporators: Charles C. Talliaferro, A. Barclay Talliaferro, James A. Rector and Thomas W. White.

Reading Heater & Supply Co., Reading, Pa., organized to conduct a heating and plumbing supply business. Among the principals is Alvin W. Varney, formerly with the United States Radiator Co.

Struble Plumbing & Heating Co., Youngstown, O., capital $10,000. Incorporators: F. A. Struble, C. A. Struble and others.

Contracts Awarded

Martin & Wigman, Green Bay, Wis., heating and ventilating new court house building at Brooking, S. D.

Bryce, Co., Toledo, O., heating and ventilating high school building at Wilmington, O., for $6,500.

Pittsburgh Plumbing & Heating Co., Pittsburgh, Pa., heating and plumbing in nine new dwellings being built on the North side for J. Texter.

F. J. Spriggs, St. Paul, Minn., heating and plumbing State College of Minnesota for $40,000; also state institutions in St. Cloud, Minn., for $20,000.

American Heating Co., Superior, Wis., heating four new buildings for the United States Steel Corporation at Superior, for $15,000.

Lewis & Kitchen, Kansas City, Mo., heating new State House at Little Rock, Ark., for $38,000.

A. S. Huffman Co., Columbus, O., ventilating and plumbing in the shops of the Big Four Railroad at Beech Grove, near Indianapolis.

Harrison Engineering Co., New York, Aertube heating and ventilating system for the Keith Theatre in Toledo.

San Francisco, Cal—The bid of the John G. Sutton Co. for heating and ventilating the new Lowell High School, amounting to $29,427, has been rejected as too high. The plumbing contract went to V. J. Belknap at $13,891, and the vacuum cleaning plant to the Pacific States Sales Co. for $985.

Fitzpatrick & Hoepfner, Columbus, O., heating, ventilating and plumbing of the new $250,000 library building at the Ohio State University, at Columbus.

An Insurance Policy on Your Heating System is the title of a 12-page booklet lately sent out by Warren Webster & Co., Camden, N. J., and illustrating some of the more prominent buildings which have been recently equipped with Webster apparatus. Five reasons are presented for the company's claim to attention, these being age and growth, experience, organization of service, efficiency of products and, finally, results. Among the notable buildings recently equipped with the Webster devices are the Metropolitan Tower Building and Fifth Avenue Building, New York; Union Station and Patent Office Building, Washington, D. C.; Boston Safe Deposit and Trust Co.'s Building and First National Bank, Boston; Union League, Philadelphia; Roxborough apartments, Montreal; Nearing Building, Toledo; Baltimore Safe Deposit and Trust Co., and the Oliver Building, Pittsburg.

United States Radiator Corporation Dunkirk, N. Y., announces the appointment of M. B. Keyes, as its northwestern manager, with headquarters at Minneapolis, Minn. Since the formation of the corporation, Mr. Keyes has been assistant manager of the New York office where his record has been a brilliant one. He will be no stranger in Minneapolis, having spent several years there in the employ of the United States Radiator Co., and his return will be welcomed by his many friends in the trade and among the architects. The corporation also announces that W. E. Hyland, connected with its Omaha branch, has been transferred to Minneapolis to the post of assistant manager. Mr. Verneke, formerly manager at Minneapolis, is leaving to go into the heating and supply business for himself.

Wanted

Position wanted by young man, ten years' experience in heating and ventilating and power piping estimating, drafting, designing, etc. Also experienced in furnace heating. Address Engineer, care Heating and Ventilating Magazine.

Wanted — First-class draftsman for laying out fan systems of heating and ventilating, estimating, etc. State salary expected and give experience. Apply Box O, Heating and Ventilating Magazine.

Wanted, a man familiar with engineering work in heating and ventilating, with some knowledge of selling. Must be posted on vacuum heating. The right party can secure advantageous position with a prominent manufacturing concern in the heating trade. Address, with full particulars, Morton, care of HEATING AND VENTILATING MAGAZINE.

THE HEATING AND VENTILATING MAGAZINE

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Heating Requirements in New York Weather

BY REGINALD PELHAM BOLTON

EDITOR'S NOTE.—An analysis of the weather conditions usually prevailing during the heating season in a city like New York may be made a very useful guide in determining the heating requirements, both for the whole period and for any given portion of the period. Such an analysis has been made by Mr. R. P. Bolton and is contained in a paper read before the Association of Edison Illuminating Companies, at its recent meeting, on the subject of "The Heating Problem In Its Relation to Central Station Lighting aud Power Service." As a rule, the papers read before this body are not available to the public but, as the result of an exception made in this instance, we are enabled to present those portions of it which deal more directly with the subject of heating requirements in a climate like that of New York City.

Under the climatic conditions of the middle and northern latitudes of this country, the artificial heating of buildings, during a portion of the year ranging in extent from 44% to 77% of the total time, becomes a necessary condition to their occupancy. The thermal requirements in the City of New York are not extreme, but are, by reason of its position at the seaboard, very variable both as regards temperature and humidity, wind and sunshine.

Although there has been in existence during the past thirty years a public company affording a supply of steam from a system of street mains, the limited area covered by its operations has scarcely affected the general demand, and the vast majority of buildings, as in other cities of magnitude, are heated by independent apparatus of all descriptions, mainly utilizing the heat of coal.

In all buildings occupied by more than one tenant, the burden of providing for the maintenance of temperature of the whole structure falls upon the owner of the property, a liability which has become extended in buildings used for light manufacturing into a supply of live steam for the use of certain tenants, and the maintenance of a supply of heated water for sanitary purposes in business and office buildings as well as in apartments. The wasteful habits of tenants render these conveniences, which are comparatively small in themselves, matters of magnitude in some cases, and in all, a matter of some uncertainty.

Also the general tendency in the metropolis towards additional height in construction has led to an immense growth in the requirements for elevator service, involving the use of power in the majority of commercial and the larger residential buildings, and in the early stages of this development the use of electricity lagged behind that of other means of operation. From this cause there developed in the business section of the city a very general practice of combining the work of heating and the generation of hydraulic power, in high-pressure steam plants which,

as the demand for electrical lighting increased, became extended into isolated electrical generating plants, manufacturing a supply of electricity for the convenience of the tenants.

It has naturally followed that such conveniences when produced upon the premises are included in rentals or offered as an inducement to prospective tenants, and the practice has so spread that it has now involved the owners of all kinds of buildings in the provision of gratuitous supplies of light and power, chiefly in the form of electricity and adapted to an increasing number of purposes in addition to the necessary provision of heat.

The general effect of the situation as above described, is unfavorable to the extension of central station electrical service, inasmuch as the heating of buildings involves the installation of some apparatus of a mechanical nature, and the employment of some labor for its operation, a condition of which those who are interested in the sale and operation of machinery for other purposes, naturally take advantage, in order to urge the installation of additional machinery, especially for the generation of electricity, combining the expenditure and labor upon the apparatus required for heating, with those involved in providing and operating generating machinery.

The almost universal practice of engineers and owners in New York City, is to use steam as the medium of the distribution of heat, and the problem of dealing with heating, therefore, limits itself to the supply of steam.

A certain demand exists in all sections of the city for steam at sufficient pressure for cooking and laundry purposes, which would seem to render it commercially desirable that any system of public supply should be one in which the pressure should not be less than 20 lbs. and possibly that already adopted by the New York Steam Company. Such a pressure would at first sight appear to be restricted to the application of a direct steam supply, and to preclude the possibility of the utilization of used or exhaust steam. This, however, is by no means necessarily the case, as there are central heating stations in operation, in which engines are operated on electrical service with a back-pressure of 35 lbs., and with arrangements, the details of which would occupy too much time herein to describe, but which would probably involve co-operation with the public

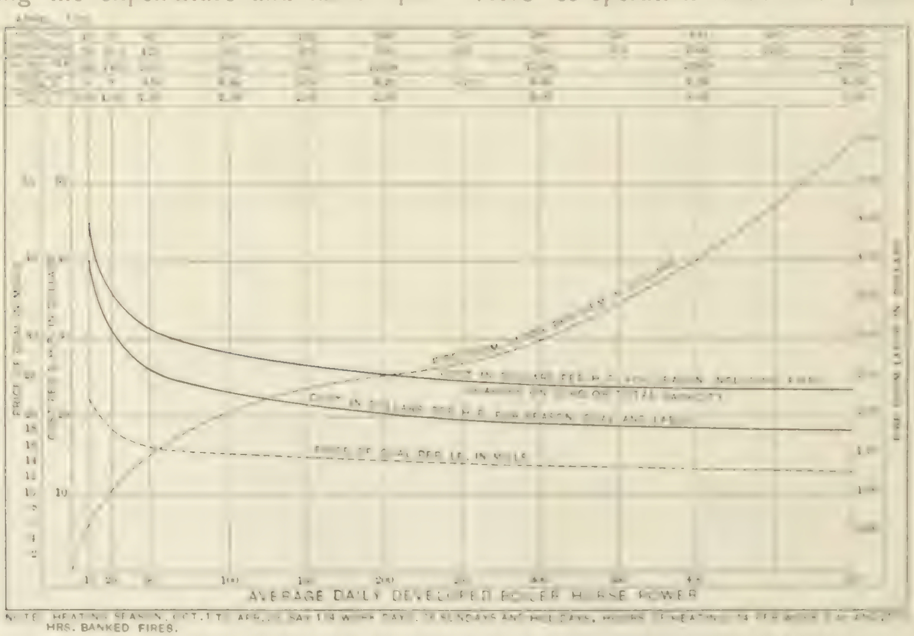


FIG. 1.—COST OF STEAM PER ONE B. H. P. FOR THE HEATING SEASON.
NEW YORK CITY CONDITIONS

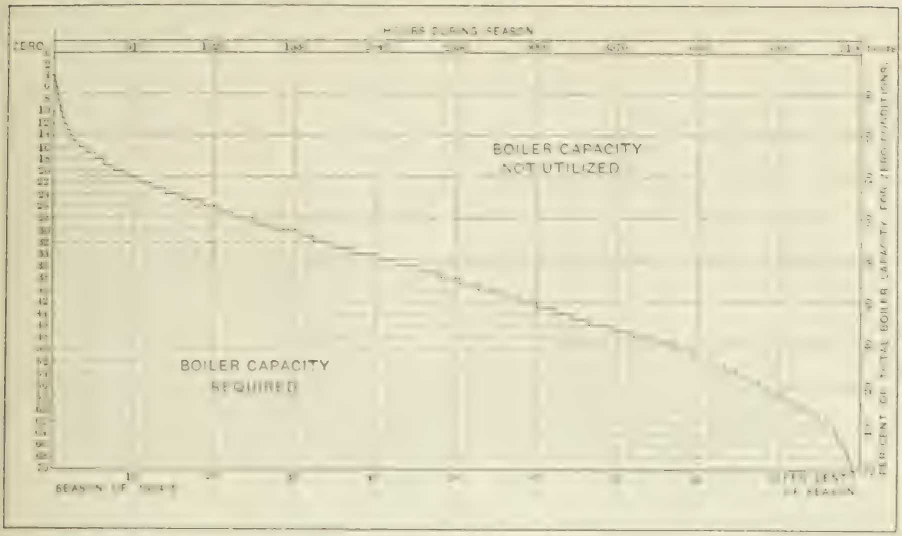


FIG. 2—PERCENTAGE OF BOILER CAPACITIES UTILIZED DURING HEATING SEASON IN NEW YORK

electric service, there is no reason why generating machinery should not be operated so as to emit used steam at even higher pressures.

The computed cost, in local installations, of a boiler horse-power for the heating season in New York City, is shown in Fig. 1, which illustrates the relative increase in cost in small installations, due partly to the quality of fuel required, to the absence of skilled labor and to the low chimneys usually to be found in small buildings. The efficiency of such apparatus is very low, and the cost of heating is excessive, amounting in steam-heated tenements to as much as one-tenth of the total gross earnings of the building.

Any domestic installation involves not only a considerable investment, but one the effective use of which is restricted, and in which during a large portion of its existence, the apparatus is actually idle, and furthermore, the climatic variations are such as to demand the installation of a capacity equal to dealing with the emergency of a zero temperature, a condition which, however, very rarely occurs in New York City.

The total use made of the capacity of heating plants under New York City conditions is illustrated by Fig. 2, in which are plotted the actual hours of the existence of various temperatures during the heating season of the year 1904-5. This diagram also indicates the relatively low load or rate of output at which heating apparatus must be operated for a large part of the period of its use, and the low efficiency which results from this feature, is one of the factors that go to render heating relatively expensive.

ASCERTAINMENT OF HEATING WORK

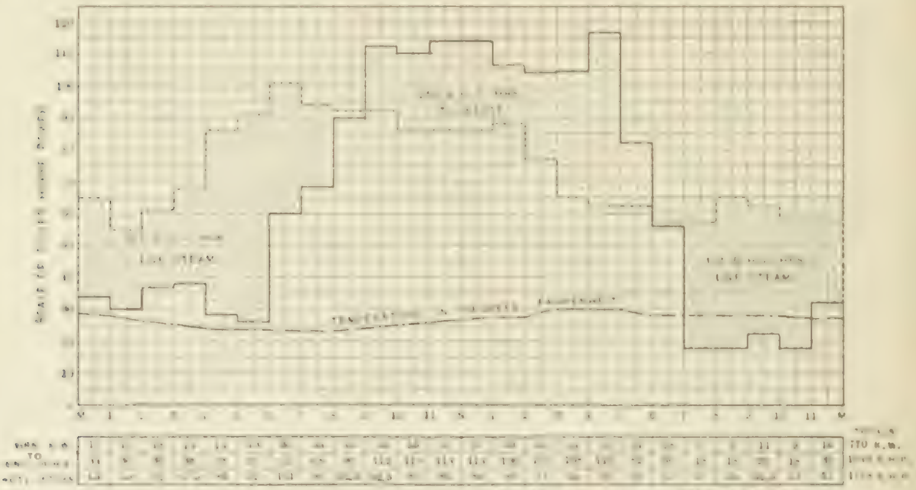
A very common practice among those who are interested in the installation of power machinery in buildings, is to exaggerate the requirements of heating, in order to bring about some ostensible relation between the exhaust of a power plant and that of the steam for heating purposes.

Such relation, in view of the comparative shortness of the heating season, as well as of its vagaries, cannot exist. The demands for power and light in a single building do not coincide with its heating requirements, though the aggregate heating of a number of buildings, many of which do not demand light or power, may approach closely to a co-ordination.

In the case of any ordinary building such results will be found as are shown in Fig. 3, which is the best observed condition as regards the utiliza-

tion of exhaust steam and is plotted from hourly steam and electric consumptions in a building where the heating demand is unusually large, due to mechanical ventilation. For other temperature conditons than those shown, a rise in the demand for steam for heating, while it would reduce the amount of exhausted steam going to waste at certain hours, would also increase the amount of live steam required to be injected into the system during the night and early morning hours. About the best result which may ordinarily be expected, is the utilization of about 60% of the exhaust for the purpose of heating during five of the heating months, or of somewhat less than 30% of the total annual use of steam.

In view of such controversial matter as has thus entered into this subject, the work of exactly computing the variations in the heating requirement of buildings has become a matter of importance, and where competition between an isolated plant and the central station supply is to be considered, this matter must be reduced to a dependable basis and must be capable of analysis and comparison with the fluctuations of demands for light and power.



Friday, March 5, 1909
[illegible]
[illegible] mean
[illegible]
Total steam 1778 + 259 = 2037 B. H. P. hours.
[illegible]
Exhaust utilized = 1281 B. H. P. hours.
[illegible]

FIG. 3.—TYPICAL INSTANCE SHOWING RELATION OF ELECTRIC LOAD TO STEAM
Actual Electric Load at Rate [illegible]

The common system of relating the work or cost of heating to the cubical contents of the building, is one which is liable to be misleading, and may lead to over or under estimation from causes that will be evident. The actual work of heating is not varied by the fact that the interior of the building is a certain size but it is directly varied by the exposure of the exterior of the building to outside temperatures and to wind effects.

The usual methods of computation applied to new buildings are based upon the ascertainment of exterior surfaces and their relative heat-transmitting values, with an addition thereto of a certain fixed allowance for cubical contents, on the ground that these contents represent approximately the amount of air leaking into the building from the exterior in one hour,—giving for one change of contents per hour:

$$\left\{ \frac{W}{4} + G + \frac{C}{55} \right\} t = \text{heat losses in units.}$$

Where W = Wall surface exposed.
G = Glass surface exposed.
C = Cubic contents of interior space to be heated.

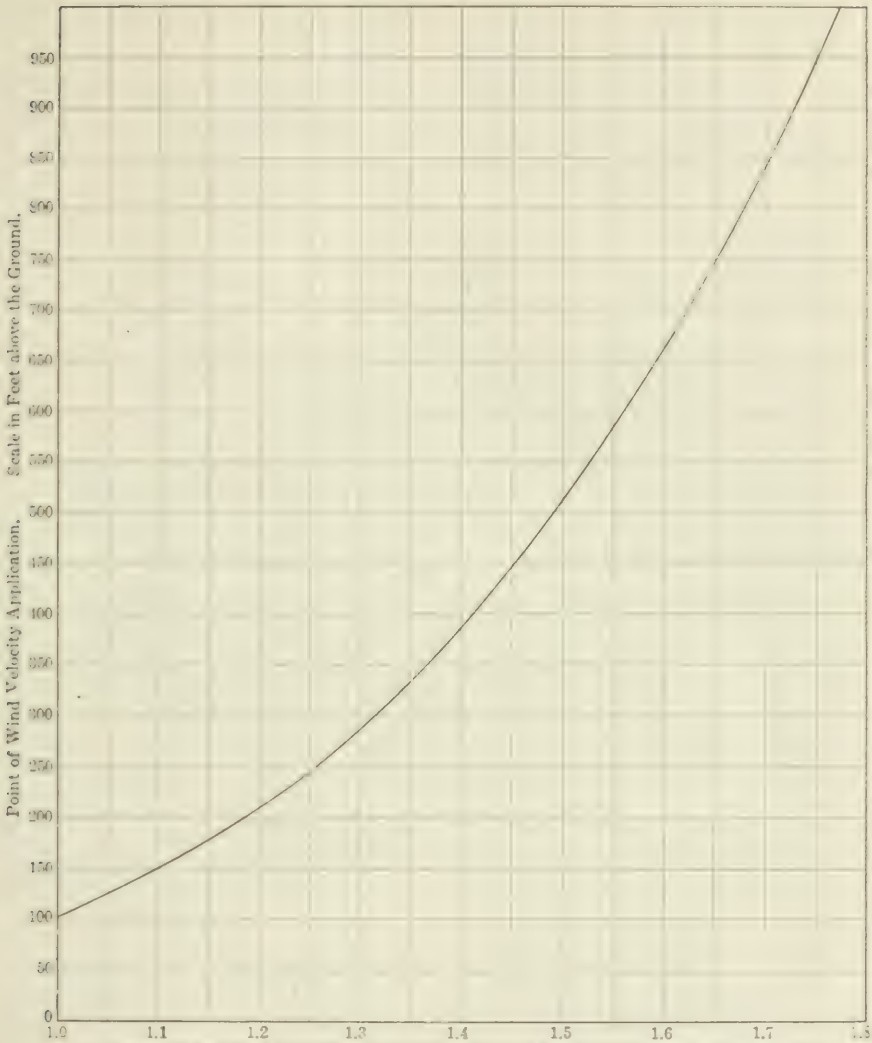


FIG. 4.—INCREASE OF WIND VELOCITY AND CORRESPONDING PRESSURE DUE TO HEIGHT OF BUILDINGS

t = Temperature difference between exterior and interior.

While the losses of heat from the exterior of a building are by this method fairly ascertainable, the loss by infiltration is empirical, and this item becomes of considerably increased importance as buildings are increased in height. Methods of building construction, while they have been largely improved in a general way, have not relatively improved in the matter of the construction and setting of window-frames, and in high and unprotected buildings, the loss of heat due to this cause is quite a substantial element in computations of this nature.

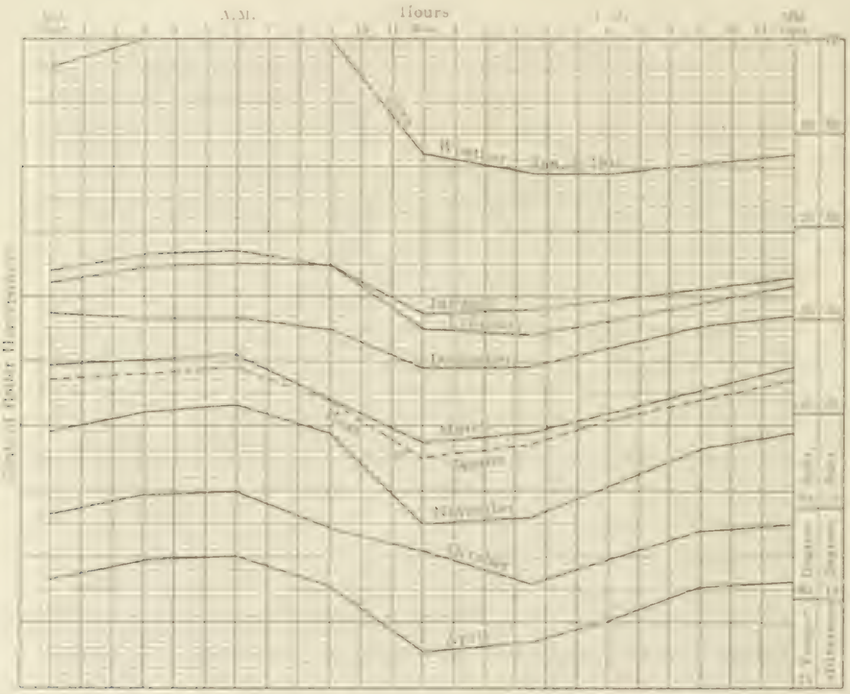
The increase of wind velocity and corresponding pressure due to height, is shown in Fig. 4, by which it will be seen that any opening or leakage point situated at a considerable height above the ground, must be regarded as of greater extent or capacity for leakage than one which is below the average level of buildings in the immediate neighborhood.

Another element which contributes to this result is the funnel or chimney effect of tall buildings which establishes, under certain conditions of wind, a strong draft through the corridors and elevator hoist-ways, thereby drawing away heat from the lower portion of the building. On account of this effect it has been found necessary in certain tall buildings, to add heating surface to the lower floors, in excess of computed requirements.

The theoretical method which has been followed by the writer, of ascertaining the heating work of the season for any building, has given very close approximations to actual results, and it may be of sufficient interest to describe herein.

An examination of the recorded variations of temperature for thirty years past has afforded the means of plotting the average hourly variations for each month of the heating season, bringing out the fact that the night temperatures are generally lower than the day temperatures, and that the work required for heating is always relatively lower at the period of maximum day work.

The diagram shown in Fig. 5 is used for the ascertainment of these average hourly conditions, the temperature curves being inverted and becoming a



Division of the Heating Season.
New York City.

Month	Days	[illegible]	[illegible]	Work [illegible]
October	16	—	2.20	[illegible]
November	30	2	[illegible]	[illegible]
December	31	1	[illegible]	[illegible]
January	31	1	4.40	25.57
February	28.25	2	4.00	22.25
March	31		4.40	26.57
April	15	—	2.14	12.80
Totals	182.25	6	25.92	150.30

EXPLANATION.

The curves are the averages of the hourly variations of temperature and represent conditions of the Season of [illegible] which was a representative Heating Season closely following the average of thirty years observations in New York City.

By ascertaining the maximum heating requirements, at Zero, of any building, the vertical scale at the left can be used for Boiler horsepowers, from which the average requirments during any month, and for any hour of day or night can be read off on the scale.

FIG. 5. HOURLY VARIATIONS OF HEATING WORK IN NEW YORK CITY AND VICINITY

relative scale of boiler horse-power, so that the average proportion of heating required at any particular part of the day in any month of the season can be rapidly ascertained. These curves are based upon the recorded conditions of the heating season of 1903-4. which were found to be very close to the general average of thirty years prior to the year 1907.

It will be seen that the maximum observed heating work which is that at the top of the diagram, on the rare occurrence of a zero temperature, falls off after the day hours, and, as has been already noted, on only about eight days of the heating season, or less than 4% of the heaing period, is there any temperature approaching the neighborhood of 0° F.

In time gone by, a temperature of zero was more frequently recorded, and as it is frequently reached in the vicinity of this city, it seems probable that the general temperature of the borough may be raised by the heat emitted from the numerous heating plants in the closely built-up center of the city.

WIND EFFECT

The effect of wind in increasing the results of low temperature has been made the subject of separate study. Combinations of high velocity and low temperature have been searched for, over the records of many years, and the most severe heating combination found has been that of a wind-speed of 42 ft. per second accompanied by a temperature of 20° F., which combination occurred on January 1, 1904, and would represent for an exposed and lofty building a condition somewhat in excess of a zero temperature in a still atmosphere. The combination is therefore adopted of a zero temperature with this wind speed in order to arrive at the suitable amount of heating surface on exposed windowed sides of any building.

The average wind movement for a month may then be utilized with effect in a computation of heating work, notwithstanding the variations of movement and direction, and the system of proportioning heating surface to meet wind effect from any point of the compass, eliminates dependence upon common methods of adding empirical amounts, such as 10% to 35% to heating surfaces on the north or other side of a building.

The effect of wind is mainly found to be in the leakage of cold air around the window-framing, sashes and meeting rails, an effect increasing with height from the surface or general level of other protecting structures. The use of close metallic wind stripping to reduce leakage around window sashes has been the subject of much discussion, and of some investigation, and in the recent experiments of Mr. H. W. Whitten, the writer had the interest of taking some part. By mounting a small room on a pivot upon the roof of the West Street building, the opening in which room was alternately provided with various forms of window construction it was possible to test the amount of air passing through the sash at various speeds and pressures of wind. The general result of this and other investigations on the subject is to indicate that the excellence or poverty of construction of window frames and sashes may affect the total heating work to be done in a building, by as much as 15%, but that the natural ventilation of occupied spaces may be almost entirely precluded by close metallic weather stripping of window sashes.

From these observations the conclusion is derived that the work of heating buildings closely follows variations of temperature, modified by the variations in wind velocity, the effect of this latter being dependent upon the number of windows and their construction, but being in all cases in the direction of an increase of the heat to be provided. This is found to be the case not only in a single exposed building, but in a large number of buildings grouped together. Thus, the Crawfordsville, Ind., (hot water) district heating plant, has an established practice of a reduction of the temperature of the hot-water supply of one degree per degree rise of temperature above zero, or an addition of 2 degrees per 1 degree fall below zero, but these modifications

are varied by the addition of one degree for each mile per hour of wind velocity.

The district heating system of the Columbus Railway and Light Company also follows the same general practice with success, varying the amount of hot water pumped through the mains, as well as the initial temperature in order to meet rise and fall in temperature with modifications to meet the velocity of the wind.

The study of wind effect has indicated that the heat transmitted through the building materials, due to the action of convection, is not materially enhanced by the movement of the air, because the action of convection in still air is always to establish a vertical current of heated air rising around the building, and the action of wind merely translates this vertical motion into a horizontal movement, at the same time creating on the lee side or sides a negative condition, reducing the motion due to convection and stagnating its action.

The method of defining the heat losses of any building which combines the elements of temperature and wind-infiltration is therefore, for 0° F. exterior and 70° inside temperature.

1. Transmission losses.
   - W = exterior exposed wall surface in sq. ft. x 21 = heat units per hour.
   - G = area in sq. ft. of window openings x 70 = heat in units per hour.
2. Leakage to be heated from all sides of building.
   - L = perimeter of window openings in feet for ordinary construction x 72 = heat units per hour.
   - = perimeter of window openings in feet for metallic stripped sashes x 31 = heat units per hour.

The sum of all in heat units, plus 15% for line and pipe losses, divided by 30,000 = Boiler H. P. required per hour to meet the most extreme weather conditions.

This total capacity placed on top of Fig. 5 gives a scale by means of which all monthly hourly averages and totals may be ascertained.

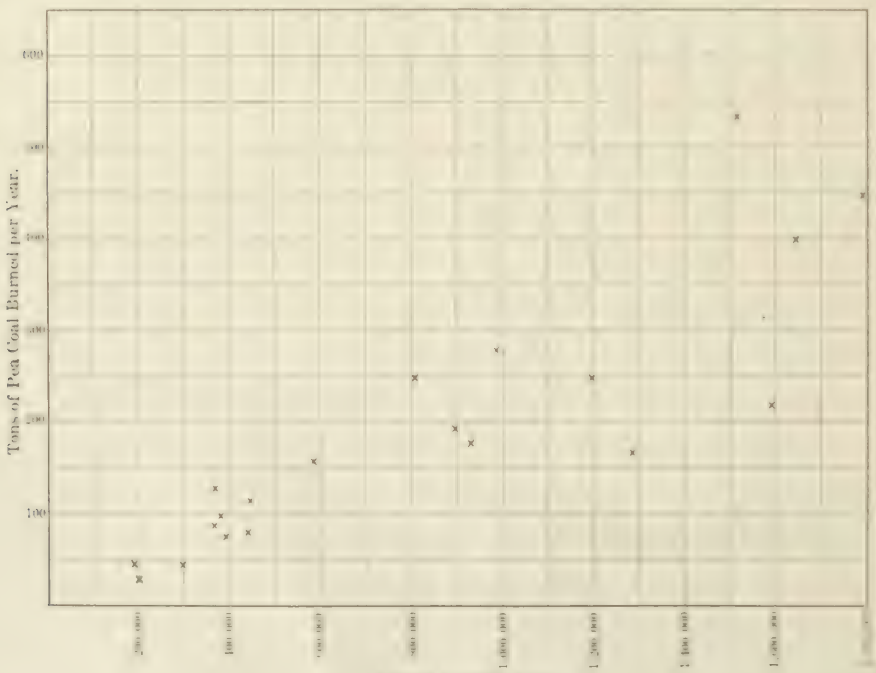


FIG. 6.—COAL CONSUMPTION IN BUILDINGS RELATED TO THEIR CUBICAL CONTENTS

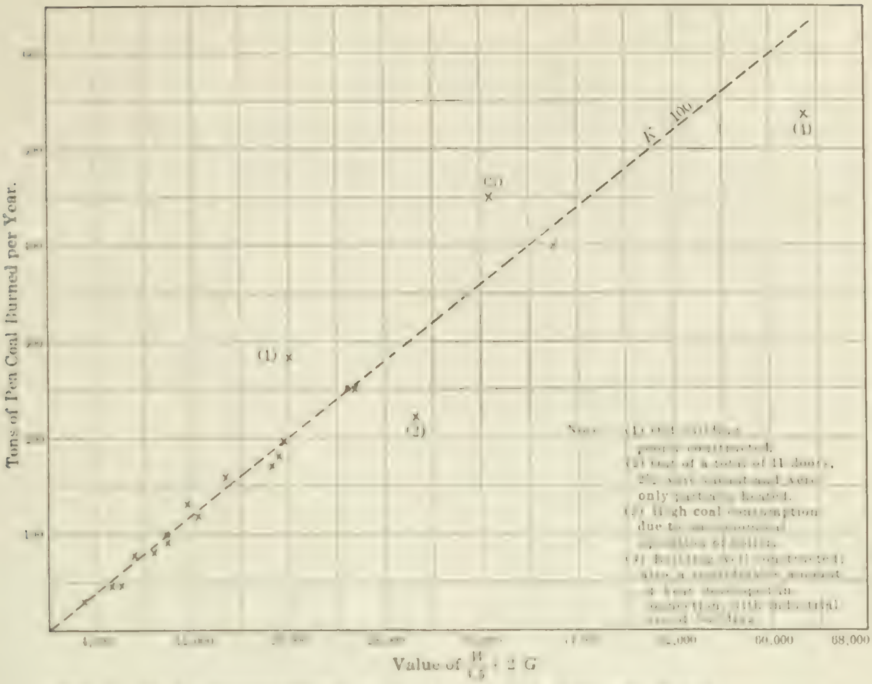


FIG. 7.—COAL CONSUMPTION IN BUILDINGS RELATED TO THEIR CUBICAL CONTENTS AND EXPOSURE

As the lineal feet in the perimeters of window openings, plus the meeting rail, is in standard types of windows equal to the amount of the area of the opening in square feet, the computation of wind leakage may be simplified by treating L as G reducing the computation to G x 70 + G x 72.

The methods above outlined, have been interestingly confirmed by observations conducted by Mr. E. F. Tweedy, of the New York Edison Company, the results of whose investigations are shown in the accompanying diagrams—Figs. 6 and 7. On No. 6 are plotted the actual consumptions of coal of a number of buildings related to a basis of their cubical contents. It will be observed that the plottings show no definite relation to one another, and that the rate of coal consumption per season per 1,000 cu. ft. appears to be same in the case of buildings widely differing in total cubical contents.

The same cases show an harmonious relation when plotted as in Fig. 7, on a basis which takes into consideration the exposures of the buildings, with due allowance for air leakage.

The observations and deductions therefrom are thus described by their author:

"Being confronted with the necessity of being able to predict with a fair degree of accuracy what the amount of coal required to heat a given building would be, I determined to secure actual coal consumption figures for a large number of buildings of different types in this city to find some relation between these coal consumptions and such physical characteristics of the buildings are are generally known to affect the heat losses. As my purpose was to obtain a relation to which the average building would conform, it was necessary to make certain assumptions, as will be evident from what follows:

"At the outset, it was necessary to adopt an average ratio for the rate of heat transmission of glass to that of wall surface, and to obtain this it was, of course, necessary to adopt some thickness of wall as representing a fair average for loft and office building construction in this city. Without entering into the details which led up to

its adoption, I will say that a ratio of $4\frac{1}{2}$ to 1 was finally adopted.

"Realizing the uncertainty which arises in providing for the leakage loss on the basis of assuming an arbitrary number of air changes per hour, I decided to combine this loss with the transmission losses. Such a combination was deemed possible by the following line of reasoning: the leakage loss being proportional to the summation of the window perimeters (assuming the leakage space to be approximately constant in width), and the sizes of windows in similar types of buildings being fairly uniform, it becomes possible to consider the leakage loss as a function of the total glass surface without any very appreciable error.

"Having made the foregoing assumptions, the following equation is obtained:

$$T = \frac{1}{K}\left(\frac{W}{4.5} + G\right) + \frac{1}{K'} G$$

Where T = tons of coal consumed per year.

W = total exposed wall surface in sq. ft.

G = total glass surface in sq. ft.

K & K' = Constants.

"As it is not necessary to solve the above equation, K and K' need not be actually determined; for purposes of plotting, however, a relation between K and K' must be obtained. For K = K' the equation evidently becomes

$$T = \frac{1}{K}\left(\frac{4.5}{W} + 2G\right)$$

"The relation between K and K' can be varied considerably without affecting the results to any appreciable extent, other than to alter the value of K. For K = K', K = 100, which is a very convenient quantity for practical use. Fig. 7 shows 20 office and loft buildings plotted from the equation in the above form, and it will be seen that the values conform very closely to the equation as given. It will be observed that pea coal was burned in all of the buildings cited. Data was secured, however, on a number of buildings where the buckwheat coals or various mixtures were being used. All such cases—as would naturally be expected, due to the lower calorific value of such fuels—fall above the pea coal line, but in most cases to a considerably greater extent than is to be explained by the difference in the thermal value of the fuels. I think that this can be accounted for by the fact that these poorer coals are very rarely burned under proper conditions as regards type of grate and draft, thereby nullifying the saving which might otherwise result from the use of a cheaper fuel.

"For apartment house buildings, the same general relation has been found to hold good, the only difference being that the value of the constant, K, is less, being about 60 instead of 100. This can doubtless be explained by the generally poorer construction of such buildings and by the fact that heating is required for more hours during the day."

For Better Air in Cleveland Schools

Principals and teachers have declared war on bad ventilation in the schools of Cleveland, Ohio. Rules providing for pure air in the school rooms and good ventilation in the halls and corridors of the school buildings were decided upon at a special meeting of the Principals' Round Table at Brownwell school auditorium.

Chief Medical Supervisor Sherman and all the teachers agreed that it was time to fight disease by means of pure air.

It was found upon discussion that on account of the heating systems of the schools proper ventilation could not be secured unless a different mode of precedure was adopted. It was voted to resort to concerted action in the window-opening proposition.

Periodically, at the sound of a gong, up go scores of windows. Then the gentle zephyrs of Lake Erie sweep through the rooms while the children are either exercising or in a safe retreat from catching pneumonia.

The So-Called Open-Air School

EFFECTS OBTAINED THROUGH LOWERING THE TEMPERATURE AND INCREASING THE HUMIDITY IN CLASS ROOMS

Perhaps no one in the country has had a better opportunity of judging the effects obtained through the so-called open-air schools than Dr. William E. Watt, principal of the Graham School in Chicago. In the various experiments he has conducted in his own school, the scholars have been placed in rooms with varying air conditions and the effect on the health of the pupils under each condition carefully noted. Some of the more important results obtained by Dr. Watt were detailed in a recent address he gave before the American School Hygiene Association in New York. Among other things, he said:

The term "open air" requires definition because there are now four sorts. In the Graham School are, at least, three varieties of open-air work as well as the important feature of humidifying and lowering the temperature of the closed rooms, and results vary with the degree of cold maintained, the degree of purity in the air, and the amount of bodily activity provided for in the course.

The first meaning of open air which suggests itself to the average mind is a place where the air is freely admitted to the school without any warming or humidifying and the pupils are bundled up in Eskimo fashion and supplied with food and footwarmers. This may mean a rather expensive form of school and is not the form of open-air work which is to be found at the Graham school either in the kindergarten or in the eight grades above it.

Our kindergarten is one in which there is not a penny expended for materials not found in the ordinary kindergarten, except that a benevolent woman has supplied each child for some months with a two-ounce bottle of sterilized milk daily. The clothing worn is that which a child ordinarily wears in attending school. During sessions the children do not lay aside their wraps unless they find the room too warm for comfort. There is more bodily activity in our kindergarten than in others, and the circulation induced and the vitality secured cause the room to seem warm to the children when to an adult unused to open air it would seem chilly.

Little children generate much more heat than adults, and one of the results of our work in open air is the conviction that parents and kindergartners generally are mistaken in their ideas of the amount of wraps a little child needs and the temperature the room should have in which he is housed and taught.

EXPERIMENTS WITH TEMPERATURE UNDER 40° F.

During the year we have permitted the temnerature at times to fall below 40° F. with a result truly surprising to those who have not seen open-air work done in cold weather. For a time we believed a temperature running down to 40° should be maintained whenever the weather will permit, that is, when the outside temperature is low enough to secure 40°.

But when I discovered that the kindergartners had procured for themselves felt slippers to protect their own feet on the cold floor, it occurred to me that as the children brought nothing extra, although they were younger and were producing more heat, it would look better to have the teachers dressed in no different costume from the ordinary, and so the temperature was raised to between 50 and 52°. This is the temperature now maintained in cold weather. Although the kindergartners preferred to have the colder room and the children seemed to like 40° better than 50°, we are keeping the temperature at 50° to 52° unless the weather forces it higher.

We tried lower temperatures than 40° with good results. Fearing the children might be enthusiastic or careless and not report when they were chilly or when their toes were cold, unusual care was taken by the teachers to make sure that none suffered in the cold. It is the belief of the two kindergartners in charge of the room that there is no danger from this score, for the children tell them freely when they are chilly or have cold feet, although the occasions are rare.

A temperature of 32° F. was maintained for awhile several times, the children positively enjoying the experiments and none suffering any discomfort. This temperature was not maintained for a full day at any time, but only for a short time as an experiment, the understanding being that the room should be warmed at once if desired and individuals might run into the warm corridor at any time, a privilege very few, I believe six, took once only.

ANIMAL HEAT HELPS VENTILATION

Animal heat is a factor in ventilation, especially in a room filled with children of kindergarten age. One of the most valuable results of our procedure is the discovery of a use for this heat in moving the vitiated air out of the breathing zone and letting pure air into that zone. Little children produce much more warmth than older persons. They dislike to be bundled up and wish to let nature have an opportunity to meet the conditions of natural air. They do not like a warm room after they have had some experience in a cool one with vital air.

There is a good reason why every well young child desires so strongly to get out into the cold to expose himself until his mother is frightened, and to revel in winds which cut his skin keenly and set his peripheral circulation into vigorous action. From observation of our kindergarten I am convinced it is healthful and invigorating for a child to expose himself more than is ordinarily permitted, a reasonable amount of caution being used, of course.

As the body naturally produces more warmth when exercised in open air, it is unnatural to have the exercise performed in warm, close air. It is also unnatural to prevent exercise by bundling the child up too much or by keeping him in a room so warm he is disinclined to exercise. I do not think the power of producing warmth is easily atrophied, but I know it is materially weakened in persons who year after year close the body away from outdoor air and keep it "protected" from any approach to inclemency.

In the cold room expired air and excrementitious gases rise directly and are crowded out of the windows at the top of the room by pure cold air entering it. This keeps the breathing zone pure, a thing distinctly new. Absolutely pure air in the breathing zone is had not only in the kindergarten, but in many other rooms where we have discontinued plenum.

WHERE THE VITIATED AIR GOES

Expired air has a high temperature. It is laden with carbon dioxide, which is 50% heavier than air at the same temperature. But there is but 4% of carbon dioxide in expired air. This does not weight it down to any great extent. In fact, expired air at a temperature of over 90° F., when set free in air under 65° is sure to rise. The colder the air in the room the more quickly will expired air rise to the ceiling. Consequently, if we had no other motive than to provide pure air in the breathing zone, we should put the temperature of our school rooms down to the freezing point.

Now let us consider what happens in air at the high temperature usual in kindergartens. Expired air at something over 90° thrown into the kindergarten where the air at the breathing zone is 70° or more, has little tendency to rise. It is slightly weighted down with carbon dioxide and its temperature is not much dfferent from that of the room. Furthermore, in the upper part of a room heated to 70° or more the air is usually much warmer still; I have found 90° in the upper part of such a room.

Carbon dioxide will not rise in such air. It will float about or fall to the

floor. Its first action is to rise slightly a few inches in front of the pupil and then gravitate back into the breathing zone, carrying foul air with it, where it is breathed by some other pupil, sent up slightly, and then it falls to the nostrils of a third pupil. Consequently, in the warm, dry kindergarten disease germs in any one pair of lungs are imparted to every other pair of lungs in the room. This accounts for the absence from the ordinary kindergarten of a large part of the membership in the cold months, when the hot, dry conditions of the room militate against the health of the pupils.

By rebreathing the air diseases are spread so effectively that no child at an age when he is particularly susceptible can escape having colds and some of the children's diseases. They are called children's diseases, not because they are peculiar to children, but because children under seven years of age are so low in their power of resistance that they are usually afflicted with some of these ills.

Adults with low resisting powers contract "children's diseases" readily. Witness the red Indian in his struggles with the measles. Weakened by housing, which is deadly to the red man, he falls an easy prey to this simple disease, and deaths from measles are very common among adult Indians who are trying to imitate the white man's vicious way of housing himself.

We keep our kindergarten cool because we are able to separate the vitiated air from the pure humidified air without difficulty and keep the breathing zone absolutely pure all the time. I say this with deliberation: We keep the air in the breathing zone of our kindergarten pure. I am aware of the belief that there is no housing which affords pure air to its occupants, but I wish to announce that we have discovered a different form of housing and are applying it to education all along the line, from the kindergarten to the high school. Furthermore, the largest private military academy in the country, over which I have charge of the ventilation, is applying pure air in the breathing zone for all students up to the time of graduation as second lieutenant in the United States army or entrance at the university with advanced standing. Four universities are now in communication with me with a view to applying it within their walls. The only obstacle to the installation of pure air in all these universities is their doubt that pure humidified air can be given to the breathing zone. The truth is, it may be had in any sort of building by the application of the principles exemplified in the kindergarten and other rooms of the Graham school.

AS TO STATURE

The stature of the pupils who have been permitted to breathe natural air in school during the past year has made an interesting advance. This was reported to me by first grade teachers who are working in pure air and have pupils which were in cold air kindergarten last year. I regret I have been too busy to gather accurate data regarding this, as the matter forced itself upon my attention only this week. I am simply reporting the words of two open-air teachers in first grade when I state that there is a gratifying increase in stature in pupils who have had this advantage during the past year. The pupils are not becoming giants, as far as we are able to judge, but they have grown unusually well.

From the first grade we gather data which throw light on what has been done in the open-air kindergarten in the past year. The young son of a physician entered the first grade fresh air room because it was not considered safe for him to attend a regular school. He was to have been sent to the country for a year at his grandparents' farm, but instead the fresh air work was chosen. He is one of the most remarkably robust youngsters in the city today, and his father, Dr. Hagey, attributes his vitality to the fresh air work.

We have had no bad results from the cold air. The worst difficulty was experienced just before Christmas, when celebrating. A child's grand-

mother attended and got cold feet. We judge cold air is a little severe on grandmothers, who merely sit and do not get into the games.

EXPERT TESTIMONY

Dr. J. MacDonald, Jr., editor *American Journal of Surgery*, New York, inspected the Graham school last month and said, "I find evidences of more good red blood in this kindergarten than in any other kindergarten I have ever seen."

Dr. Woods Hutchinson has twice visited us and speaks with enthusiasm of the fresh air results.

Miss Henriett Roos, one of our kindergartners, says, "The children are much more alert than ordinarily housed kindergarten children. They learn songs in a week which used to take three in warm, dry air. Their hand work goes quicker. They do not need nearly as much direction. At first I thought it an unusually bright set of pupils, but find the new ones this year work better, or as well, as those in open air last year." Of the attendance, she reported that in cold weather, when the ordinary kindergarten is depleted by illness and fear of cold, but six or eight of the cold-air children are absent on the average. More children are probably in attendance there this cold morning than in any other kindergarten in Chicago.

RADIO ENERGY RIVALS OXYGEN

A year ago I earnestly asked the members of this society to tell me the reason that pupils in open rooms improve physically so rapidly. I thought it could not be due entirely to the better air. The best reply I received was that window glass shuts out the ultra violet rays of light, which have much to do with vitality. At the time I was asking this question, Professor Rutherford, of McGill University, was declaring in another convention that the action of radium emanations in the atmosphere must have a profound physiological effect, the data of which we are entirely ignorant of at the present time.

I think he had my answer and I the facts he was wishing for. The new science which Mme. Curie has given to the world seems to prove that the air is animated with supremely fine oscillations, which come from the escape of emanations of radium from the earth. The gases which compose the atmosphere are ionized by these emanations. When such air is breathed we find it is a great stimulant to healthy activity and resistance to disease.

The physiological effects of radioactivity and the X-ray are practically the same, as are also those of the ultra violet rays. Now, in our fresh-air kindergarten and fresh-air rooms of the Graham school, we are applying radioactivity in the very place where other schools apply dead air with fatal or crippling results.

We are giving our pupils a safe wireless X-ray treatment from within. This stimulates the tissues and weakens the bacteria.

Air that is heated loses its radioactivity. Air that is perfectly correct in its component parts may be dead, devitalized and unable to afford vital energy. We can live in it, but at a poor dying rate. I attribute the splendid physical and mental condition of our open-air pupils more to the beneficent energizing of radioactive air than to the purity of the air in our open rooms.

A Nebraska Hygienic Programme

Following is the health programme recently proposed by the Nebraska Association of School Principals and Superintendents:

Compulsory installation in school houses of ventilating heating plants.

Compulsory cleaning and disinfecting of school houses at least twice a year.

Compulsory submission of all school house plans to a state architect for approval.

Compulsory medical inspection of school children.

Compulsory medical inspection of all school teachers.

"So far as people's health is concerned," comments the Lincoln (Neb.) Journal, we are scudding into socialism at the speed of a gale." At the same time it approves the proposition.

*Ventilation of the Capitol, Washington, D. C.**

A CASE OF FAULTY DISTRIBUTION WITH AN UP-DRAFT SYSTEM

By Nelson S. Thompson

In accordance with the request of Prof. James D. Hoffman, I take pleasure in presenting the following report of Passed Assistant Surgeon Norman Roberts, Hygienic Laboratory, United States Public Health and Marine Hospital Service, on the ventilation of the Capitol, Washington, D. C., with some comments thereon by Mr. H. C. Russell, a candidate for membership of the society, and a brief description of the apparatus to be used by the office of the Supervising Architects, Treasury Department, in determining the purity of the air in buildings under its control.

The following is the report of Dr. Roberts:

"In this examination there were made one qualitative test for sulphur compounds, one for carbon monoxide, four quantitative determinations of ammonia, and forty-two of carbon dioxide.

"The test for sulphur compounds indicated their presence, but in such small quantity as not to justify the very considerable labor of determining the exact amount present. Sulphur compounds, mainly the dioxide, are present in greater or less amount in the air of all large cities, or in general wherever coal is being burned in any considerable quantity within a number of miles to the windward, but are of no hygienic significance unless in considerable concentration.

"The test for carbon monoxide (furnace gas and illuminating gas) was negative.

"The determinations of ammonia resulted as follows:

		Grams per Cubic Meter.
House Floor.	(1).....	0.00037
	(2).....	0.00038
Senate Floor,	(1).....	0.00041
	(2).....	0.00031

"These amounts of ammonia are without significance under the circumstances.

"The determinations of carbon dioxide are given on the following page in the order in which they were made.

"The permissible limit of carbon dioxide in the air has been somewhat arbitrarily fixed at 20 parts per 100,000 *above* the amount in the outdoor air, i. e., the amount of *respiratory* carbon dioxide must not exceed 0.0002. Hence in this investigation any reading about 48 would ordinarily be taken as indicating undue respiratory contamination and poor ventilation, the mean reading for the outdoor air being about 28.

"The process employed for the determination of the carbon dioxide (Pettenkofer's method, slightly modified) is quite exact, and it is believed that 2 parts per 100,000 represents the extreme error. This error is demonstrated in determinations 23 and 24, which should have agreed. The error resulted from not sufficiently shaking up the vessel after the introduction of the barium hydroxide solution; and reaching a probable maximum of 2 parts per 100,000 at reading No. 24 is believed to have begun at about reading No. 10, the results beginning to be slightly low at this point.

"The outside air may be considered to contain about 28 parts of carbon dioxide per 100,000 (see readings Nos. 13, 21, 23, 24). The exhaust air from the two chambers showed 32, 37 and 40 parts (readings Nos. 11, 14, 15 and 34), a fair average for this air, during a long session of the house, being probably something less than 40.

"The basement air seems to be quite pure, in consequence of the circulation due to the heat of the engine rooms. Of course, in occupied, poorly ventilated spaces, of which there are a number in the Capitol basement, the

*Read at the annual meeting of The American Society of Heating and Ventilating Engineers, New York, Jan. 24-26, 1911.

		Parts per 100,000
1.	Temporary laboratory, Capitol basement (terrace)	66
2.	Same, after longer occupation	77
3.	House inlet, just inside door to basement	33
4.	Same	30
5.	House, men's gallery	61
6.	House floor, rear of Democratic side	41
7.	House basement, at door to engine room (draft into basement)	28
8.	House floor, Democratic side, east end	39.5
9.	House floor, Republican side, west end	45
10.	House floor, Democratic side, near center aisle (Wicklif)	57
11.	House attic, shortly after adjournment	32
12.	House basement, draft outward into engine-room	47
13.	Air inlet, senate	27
14.	Senate attic (in session two hours)	37
15.	House attic (in session four and one-half hours)	37
16.	House floor, Democratic side, near center aisle (Wicklif)	31
17.	Same, Republican side (Keane?, New York)	46
18.	Senate floor, open space in front of Chair	57
19.	Same, back, Democratic corner	39
20.	Same, Republican side, between Smith and Stevenson	54
21.	Senate inlet	26
22.	House duct, to windward of fan	29
23.	House inlet	26
24.	Same	28
25.	House basement, near engineer's office	[illegible]
26.	Senate floor, front, Democratic corner	48
27.	Senate floor, Republican side	60
28.	Senate floor, front of Chair	61.5
29.	House floor, front of Chair	103
30.	House floor, middle row, Republican side	41
31.	House floor, front of Chair	[illegible]
32.	House floor, Republican side, third row	50
33.	House floor, Democratic side, front row, near wall	66.5
34.	House attic (session two hours)	40
35.	Temporary laboratory, terrace	80
36.	House floor, front of Chair (changes of position)	41
37.	House floor, Republican side, fifth row (changes of position)	[illegible]
38.	House floor, Democratic side, fourth row (changes of position)	29
39.	House floor, through pipe, middle of Democratic side	32
40.	House floor, back part of Republican side (changes of position)	[illegible]
41.	House floor, front of Chair (changes of position)	43
42.	House floor, front of Chair (one position)	72

air promptly becomes contaminated. This contaminated air tends to ascend into the halls and rooms above, and it is believed that the elimination of the sources of heat in the basement (the removal of boilers and engines when the new powerhouse is put into operation) will prevent this additional contamination of the upper stories.

"The condition of the air on the floors of the chambers was at first a puzzle. The readings obtained from the exhaust air in the attics were low; yet the carbon dioxide readings on the floors varied unaccountably from 31 to 103 parts per 100,000. This wide and irregular variation was finally accounted for as follows: The specimens were taken by sucking the air out of the bottle by a rubber tube, into the lungs, the air from the room filling the bottle at the same time, care being taken to discharge the expired air from the lungs away from the bottle; and where there was a strong air current, as in the air inlets and outlets, none of the carbon dioxide expired from the experimenter's lungs got into the flask and the readings were low. On the floors of the chambers, however, the motion of air was very slight, and the experimenter's breath contaminated the whole atmosphere for a radius of several feet from his face, including, of course, the portion of the air from which the sample was drawn.

"On the other hand, when precautions were taken to escape this contaminated air (as by taking the specimen through a pipe from below the

floor, No. 39, or by moving while taking the specimen), the readings were again relatively low. The effect of this is shown by results Nos. 41 and 42, in which the conditions were practically identical, except that in one case the examiner moved about, while in the other he stood still, and, holding the bottle well out of the way during expiration, held the bottle as near as possible to the face during inspiration, so that the air which went into the bottle very accurately represented the air as it is actually breathed by the members on the floor during a session.

"At first sight it would appear that the results obtained when part of the carbon dioxide in the sample came from the experimenter's own breath should be considered of no value. On the contrary, when controlled by experiments in which this factor is eliminated, they are highly instructive, since they show that conditions are such that, although an abundance of air is supplied, the distribution is faulty, and the members occupying the floors of the chambers rebreathe their own breath, while a large quantity of pure air passes unchanged and unmixed through the chambers to the outlet."

APPENDIX TO THE REPORT ON THE ANALYSIS OF THE AIR AT THE CAPITOL

"The method employed for the determination of the carbon dioxide was a modification of Pettenkofer's method, as follows:

"Several glass containers, holding in the neighborhood of 4,000 c.c., were measured as to their cubic capacity by weighing first when empty and dry, and then when filled with water. Elenmeyer flasks with mouths about 1½ in. in diameter were preferred on account of the convenience in cleaning and drying, but not enough of these were available, and bottles of the ordinary shape had to be used sometimes. These containers were stopped with rubber stoppers, which in turn were bored with a hole about ⅜-in. in diameter, and closed with a small, hard, red rubber stopper.

"In taking the sample air in the bottle was sucked out by a rubber tube reaching to the bottom, the larger stopper being removed. About 10,000 c.c. of air, on the average, were passed through the bottle; the mouth was then tightly closed and the bottle taken to the laboratory. Fifty cubic centimeters of barium hydroxide solution of known strength (see below) were introduced by means of a burette through the hole in the large stopper, the small one being removed. The flask was then again tightly closed and set away for an hour or more, the contents being gently agitated at intervals. (The occasional agitation appeared to be necessary to complete the absorption within a reasonable time.)

"In the meantime some of the same barium hydroxide solution was titrated against the standard oxalic acid solution as follows: 25 c.c. of the barium solution was run from the burette into a 100 c.c. volumetric flask and one drop of 1% phenolphthalein solution added, producing a deep red coloration. From another burette the standard oxalic acid solution was added until the color was exactly discharged. The oxalic acid solution contained 2.819 grams of acid to the liter, and one cubic centimeter was equivalent to 0.5 c.c. of carbon dioxide at 0° C. and 760 mm. pressure.

"The value of the 50 c.c. of barium hydroxide solution being thus determined, and sufficient time having elapsed for the complete absorption of the carbon dioxide in the sample of air in the 4,000 c.c. container, a drop of the phenolphthalein solution was introduced into the latter, a final shake given to color the liquid uniformly, the small stopper removed, and the nozzle of the burette containing the oxalic acid solution introduced, and the acid run in until the color was exactly discharged. The difference between the strength of the barium solution weakened by the carbon dioxide in the large container, and of the unaltered barium solution, represents the amount of carbon dioxide in the sample. A correction for temperature and pressure must be

made, and for convenience a table covering the ordinary ranges of temperature and pressure may be made.

"The following is a sample of the results:

DETERMINATION NO. 16, 4:50 P.M., MARCH 29, 1910.

Floor of House, just after adjournment; Democratic side, near center aisle (Wicklif· Louisiana.)

Temperature, 25° C. Correction factor, 92.3%.
Barometer, 30.16 in.

50. c.c. $Ba(OH)_2$ sol. (unaltered).............................. 31.6 c.c. oxalic acid.
50. c.c. $Ba(OH)_2$ sol. (after exposure)........................ 29.3 c.c. oxalic acid.

2.3 c.c. difference.

1.15 0.923 1.24 1.15 c.c. CO_2 in sample (at 0° C. and 760 mm pressure).
0.00031 1.24 c.c. at 25° C. and 30.16 in. pressure.

4000) 1.24000 (31 volumes of CO_2 per 100,000.
1.2000

"This procedure is a slight modification of that given in Kenwood's 'Public Health Laboratory Work,' 4th Ed., London, 1908, pp. 160-168.

"The ammonia was determined by drawing 100 liters of the air slowly through a train of three wash bottles containing ammonia-free distilled water. The air was drawn through a lead pipe opening above the level of the tops of the desks about midway from front to back of the chamber, and connected below into the 'plenium' or fresh air space below the floor, through a ventilating opening, where it was connected with the train of wash bottles. The absorbed ammonia, 'free' and 'albuminoid,' was then determined as in water analysis, by distillation and Nesslerization. The two varieties are reported together, instead of separately, because it was impossible to make the distillation until the next day, and the distinction is not as significant in the case of air as in water.

"The sulphur compounds were tested for by slowly passing the air through bromine-water in a train of absorption bottles, whereby the sulphur was oxidized to sulphuric acid. This was tested for by the addition of barium chloride solution and dilute nitric acid. The reaction was controlled by parallel tests on (1) a sample of the same water through which outdoor air had been passed (at the Hygienic Laboratory), and (2) a sample of the same water untreated.

"The carbon monoxide was tested for by shaking up a liter of the air with a dilute blood solution and comparing the color with that of a similar portion of the same blood solution not exposed to the possible action of carbon monoxide.

"All of these methods are derived, with or without modification, from the descriptions in Kenwood's 'Public Health Laboratory Work' (*supra*), in the section on Air Analysis, pp. 149-168."

It might be well to state that Dr. Roberts makes no pretense to being a ventilating expert except as it refers to hygiene.

Attention is called to the following: It will be noted that the report always refers to the CO_2 constituent as parts in 100,000, whereas the heating and ventilating engineer usually refers to it as parts in 10,000 parts of air.

The CO_2 constituent in the air intake, readings No. 13, No. 21, No. 23 and No. 24, average 27 parts in 100,000. This is very low reading, and is accounted for by the fact that the intakes are on the capitol grounds several hundred feet away from the slightest source of contamination and long distances from any serious source of contamination.

The system of ventilation used in the Senate and House chambers is the up-draft. The air is admitted by multiple floor openings, in the legs of the members' desks, etc., and escapes through a perforated ceiling, through which it is drawn by exhaust fans.

The air quantities circulated are

sufficient for excellent ventilation, which is evident upon comparing readings 13, 21, 23 and 24 with 11, 14 and 34, the CO_2 constituent increasing from an average of 27 to an average of 35 parts in 100,000, yet the readings obtained at the floors of the chambers were very much greater, one case (No. 29) being 103.

In the report above quoted Dr. Roberts explains that some samples were taken while he was standing still in the chamber, while others were made with the experimenter in motion. It seems rational to consider the former as the kind of samples in which we are really interested, because they represent just the kind of air a member sitting still in his seat is breathing. The relatively purer air in the aisle beside him or in the "foul air" space in the attic above him does him no good.

It seems that Dr. Roberts was justified in his conclusion that the distribution is faulty, and that a large part of the air as soon as it entered at the floor took a "beeline" for the ceiling openings, and there was little or no diffusion, or at least what diffusion there was took place above the breathing line.

Whether or not better results could have been secured with the downward circulation or some other method is a question on which the experts will disagree, but it is undoubtedly a fact that in this case the upward circulation system had a fair show.

The important point we see emphasized in Dr. Roberts' report is that when we test the CO_2 constituent in an occupied room our result will depend more or less upon where and how we take the sample. A sample taken in the foul air duct might mean little or nothing, especially if the occupants of the room were sedentary. In this case we should get our samples, as it seems to us, near the occupants' heads and in such a way, as Dr. Roberts did to represent accurately the same air the occupant was breathing and not the air over his head or beside him. The closer the results obtained from these samples agree with those obtained from the air in the foul air duct the more efficiency we are getting out of a given quantity of fresh air introduced.

How Wind Affects the Heating of Buildings

Interesting tests showing the effect of wind velocities on the heating of buildings, including the effect of air leakage around windows, are reported in an investigation conducted by a committee on the subject, representing the American Society of Heating and Ventilating Engineers.

The test for wind velocities was made on a group of buildings comprising the Harvard Medical College in Boston. The following tables give the results of these tests, which were presented at the society's recent meeting in New York. The tests for window leakage contained in the report will be presented next month.

HARVARD MEDICAL COLLEGE

A large group of buildings heated from a central plant by means of a forced hot water system. Direct radiation and indirect fan system. Fans in use from 8 A. M. to 6 P. M., Monday to Friday, inclusive. Saturday fan in use from 8 A. M. to 1 P. M.; Sunday, direct only. Use of buildings is such that conditions on one day of the week will compare nearly with same day of the following week. B. T. U. supply determined by recording thermometers on supply and return. Venturi meter determines amount of water circulated. Manometer readings hourly.

Wind velocities and direction and outside temperature taken from U. S. Bureau Records at Federal Building, Boston.

A table showing comparative days of week for January and March, 1910, from the chief engineer's log.

The buildings are of high class construction, and have usual proportion of windows compared with wall surface. Glass area not excessive.

DATE.	Total B. T. U. Supply. 24 Hours, Millions.	Average Outside 8 A.M. to 6 P.M. Hourly, Readings, Deg. F.	Average Outside Temp., 6 P.M. to 8 A.M. Hourly Readings, Deg. F.	Average Wind Velocity Miles per Hour, 8 A.M. to 6 P.M. Hourly Readings.	Average Wind Velocity Miles per Hour, 6 P.M. to 8 A.M. Hourly Readings.	Direction of Wind.
SATURDAY.						
Jan. 1, 1910........	143	31	35	10.2	16.	S.W.
" 8, "	123	28	26	10.2	6.4	W.&S.W.
" 15, "	232	26	25	20.9	13.8	N.
" 22, "	45	45	37	8.4	16.9	S.W.
" 29, "	100	38	32	10.6	24.8	N.&.W
SUNDAY.						
Jan. 2, 1910......	123	43	36	14.2	9.5	S.W.&W.
" 9, "	131	30	26	3.5	9.	S.W.&N.
" 16, "	143	38	30	6.7	9.1	N.W.
" 23, "	105	39	34	12.4	6.	S.
" 30, "	98	33	32	18.	8.3	W.&N.
MONDAY.						
Jan. 3, 1910........	191	22	21	[illegible]	21.	W.&N.W.
" 10, "	191	30	17	17.3	11.4	N.&W.
" 17, " ...	156	34	34	7.4	15.4	E.&S.
" 24, " ...	131	39	38	15.1	14.7	S.&E.
" 31, "	191	31	27	12.4	15.8	N.
TUESDAY.						
Jan. 4, 1910........	303	6	−1	18	11.6	N.W.
" 11, " ..	213	26	24	11.4	9.2	W.
" 18, "	111	46	45	16.9	13.1	W.&S.W.
" 25, "	119	37	35	10.1	10.8	N.&E.
WEDNESDAY.						
Jan. 5, 1910........	183	15	22	6.8	8.2	N.W.&S.W.
" 12, "	153	30	28	9.	8.	W.&N.W.
" 19, "	150	40	32	14.3	9.5	W.
" 26, "	109	40	37	9.5	5.5	W.
THURSDAY.						
Jan. 6, 1910......	114	35	40	10.7	6.5	W.&N.
" 13, "	195	30	28	5.5	12.	N.W.&N.E.
" 20, "	136	39	38	8.	7.2	W.&S.W.
" 27, "	127	36	37	7.6	14.2	W.&N.
FRIDAY.						
Jan. 7, 1910......	121	35	24	15.2	10.7	W.
" 14, "	221	26	18	27.1	21.7	N.E.&N.
" 21, "	79	46	52	15.8	27.	E.&S.
" 28, "	103	38	35	8.7	10.7	W.&N.

DATE.	Total B. T. U. Supply. 24 Hours, Millions.	Average Outside 8 A.M. to 6 P.M. Hourly, Readings, Deg. F.	Average Outside Temp., 6 P.M. to 8 A.M. Hourly Readings, Deg. F.	Average Wind Velocity Miles per Hour, 8 A.M. to 6 P.M. Hourly Readings.	Average Wind Velocity Miles per Hour, 6 P.M. to 8 A.M. Hourly Readings.	Direction of Wind.
TUESDAY.						
March 1, 1910 ..	99	39	36	16.	10.	N.E.
" 8, " ..	94	37	30	6.6	7.3	W.&N.W.
" 15, " ..	142	40	32	17.3	9.8	W.
" 22, " ..	47	50	48	7.1	8.7	S.W.
" 29, " ..	53	67	58	14.	6.	W.
WEDNESDAY.						
March 2, 1910..	138	38	35	15.	18.	W.
" 9, " ..	117	40	29	10.	11.8	W.&N.W.
" 16, " ..	129	45	34	11.7	10.6	W.&N.
" 23, " ..	91	43	37	10.7	5.	E.
" 30, " ..	65	50	45	9.8	7.3	E.
THURSDAY.						
March 3, 1910.	93	45	42	12.	9.	W.&N.W.
" 10, "	114	34	30	8.6	6.2	N.&N.W.
" 17, "	131	29	22	12.6	10.6	N.&N.W.
" 24, "	70	55	53	14.6	16.	S.W.
" 31, "	65	43	43	11.4	10.5	E.&S.W.
FRIDAY.						
March 4, 1910..	81	43	42	10.	8.	W.&S.W.
" 11, "	112	36	33	8.5	6.2	N.&N.E.
" 18, "	103	35	31	8.7	7.	N.W.&S.W
" 25, "	30	72	50	18.9	11.3	S.W.
SATURDAY.						
March 5, 1910......	49	50	42	10.5	8.	S.W.
" 12, "	104	46	34	18.4	11.	N.&N.E.
" 19, " ...	30	44	42	12.8	13.	S.W.
" 26, " ...	49	40	43	17.9	10.5	N.W.
SUNDAY.						
March 6, 1910.....	52	40	45	8.4	10.	E.&S.
" 13, " .	78	39	38	12.4	8.7	N.&W.
" 20, " .	26	61	43	18.5	11.	S.W.&N.W.
" 27, " .	70	43	38	10.7	10.	W.&.N.W.
MONDAY.						
March 7, 1910 .	94	44	34	[illegible]	14.	W.
" 14, " ..	145	36	28	19.	12.	W.
" 21, " .	79	43	37	8.7	13.	N.W.&S.W.
" 28, "	85	50	49	16.7	13.	W.&S.W.

The Durability of Welded Pipe in Service

By F. N. Speller

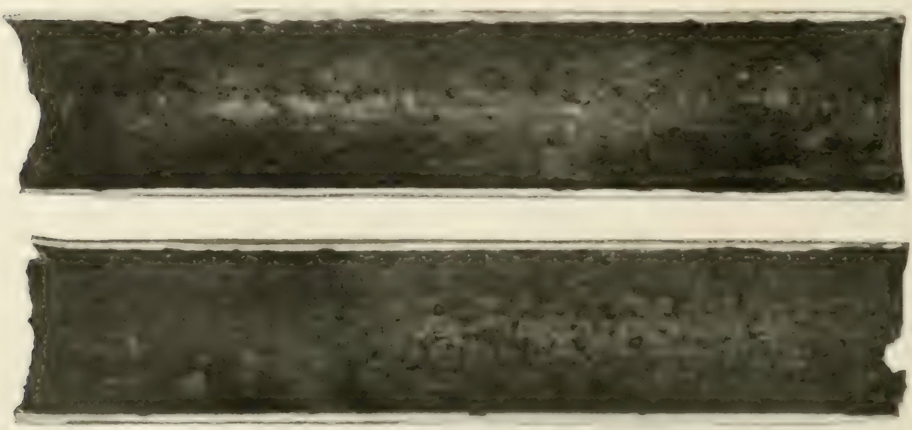
A further contribution to the discussion of the subject of the relative corrosion of wrought-iron and steel pipe is contained in the following paper, which was read from manuscript at the recent annual meeting of The American Society of Heating and Ventilating Engineers. In citing instances where the two kinds of pipe were subjected to comparatively the same conditions, the author makes out a strong case in favor of steel pipe from the standpoint of durability.—[Editor's Note.]

In again opening this much worn subject for discussion before this society it is my intention to touch on the results of recent investigations which it is believed have a most practical bearing on this important matter.

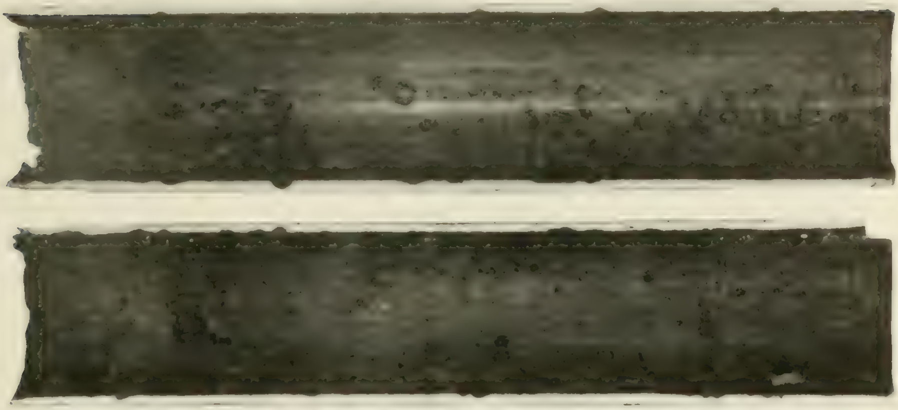
Before proceeding, let us for a moment review the fundamental reactions involved in the corrosion of iron, so as to have a clear conception of what is going on when, as we say, a pipe rusts. The most satisfactory theory of corrosion is based on the fact that iron is slightly soluble in water, a property common to nearly all materials in nature. In itself this is not of serious consequence, since the quantity dissolved is so extremely small. Moreover, when iron is dissolved the water gives up an equivalent amount of its dissociated hydrogen, which is, so to speak, plated out on the surface of the iron, causing polarization and retarding further solution of the metal. Solution is further retarded by the water becoming saturated with iron as ferrous hydrate.

If we are dealing with water free from dissolved oxygen or acids, an equilibrium is thus soon established, but if oxygen is present it combines with the free hydrogen on the surface of the iron, exercising thereby a depolarizing effect and allowing more iron to go into solution. The ferrous hydrate in solution is oxidized to insoluble ferric hydroxide and precipitated as rust, thus leaving room for more iron to pass into solution.

Therefore, provided a continuous supply of oxygen is at hand, corrosion continues until the pipe is destroyed. Other things will accelerate the reaction, such as the presence of stray electric currents, increased galvanic action on the surface of the metal, the action of acids, etc., but, practically speaking, in the case of water pipes, the amount of corrosion is nearly proportional to the quantity of oxygen brought in with the water, so that water free from dissolved gases is usually quite harmless and will not even discolor the bright surface of iron after years of exposure. It also holds true that air free from moisture is equally



PIPE No. 24.—HOT WATER, BOILER FEED WROUGHT IRON PIPE AFTER TWO YEARS, FOUR MONTHS' SERVICE



PIPE No. 24 S—HOT WATER BOILER FEED STEEL PIPE AFTER TWO YEARS, FOUR MONTHS' SERVICE

inactive and will not cause rusting; but we are not concerned with that phase of the problem at this time.

The elementary reaction of corrosion being one of solution, the physical condition of the metal, uniformity in composition, and the nature of the protective coating evidently have an influence on solubility of iron and, therefore, on the rate at which rust will form. These are points which the leading interest in the manufacture of steel pipe has paid considerable attention to for several years past, since the practical significance of these things has been better understood. It is important to remember, however, that solution starts on the surface, and, therefore, that accidental differences in the condition of the surface may be much more influential in promoting solution of the metal than irregularities in the metal itself. This applies particularly to mill scale which forms with iron a galvanic couple having a potential many times greater than the worst possible case of segregated or irregularly distributed impurities found in the metal.†

†In order to see if there was any relation between the quality of the material judging by the chemical analyses and the local pitting due to corrosion, we selected two pieces of what turned out to be wrought iron pipe from the same line, one sample of which (No. 44) was comparatively free from corrosion, while the other (No. 45) was badly pitted all over. The analyses of drillings taken from these samples are given below:

No. 44.		No. 45.
.160%	Phosphorus	.120%
Trace	Manganese	.13
Trace	Carbon	Trace
2.95	Oxides	3.40

In another case a piece of wrought iron was found to be pitted in a few places, but by far the larger portion of the inside surface was free from corrosion. Analyzing the pitted and the clean surface we found the following composition:

	Sample No. 1	
	Around Pits	Clean Surface
Sulphur	.023%	.019%
Phosphorus ..	.370	.310
Manganese	Trace	Trace
Carbon	Trace	Trace
Oxides	2.75	3.00
	Sample No. 2	
	Around Pits	Clean Surface
Sulphur	.021%	.020%
Phosphorus ..	.337	.315
Manganese	Trace	Trace
Carbon	Trace	Trace
Oxides	2.80	3.00

This does not indicate any significant difference in composition. The probable explanation for the difference in effect on materials like the above which have practically the same composition is that the surface exposed to the water was in one case better protected than in the other by the mill scale which naturally forms in the process of manufacture.

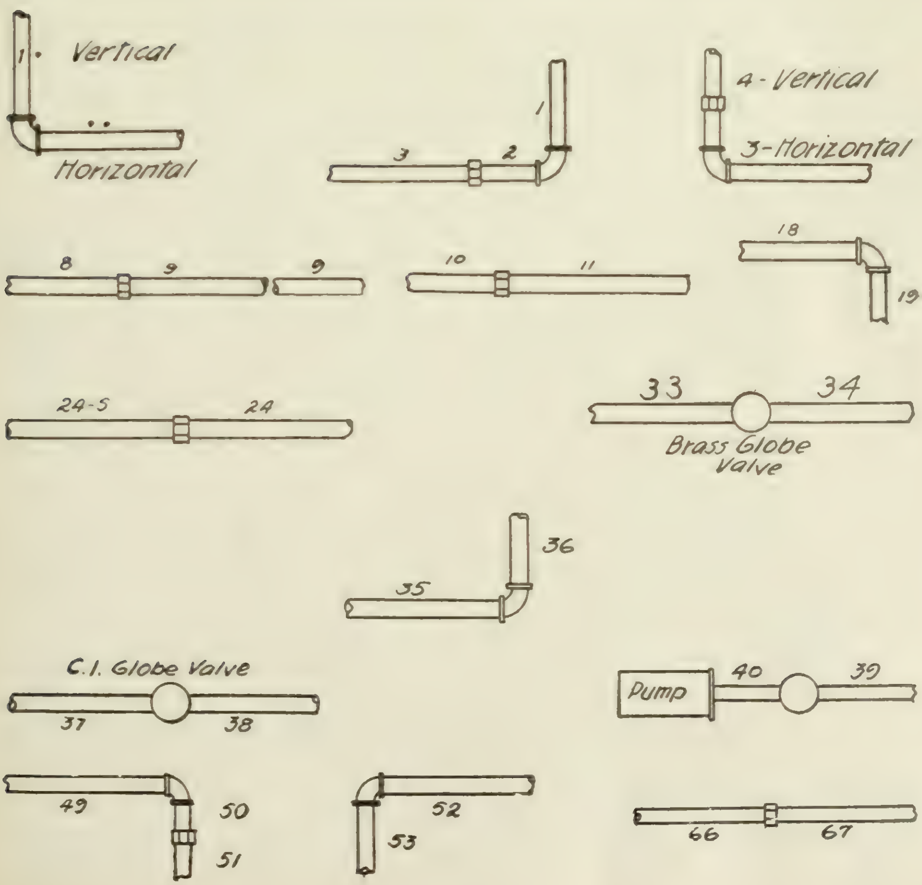
The author, knowing that in the past fifteen years iron and steel pipe have been made and sold side by side, undertook some investigations to see whether the iron and steel had been by chance installed together in the same lines. Obviously, this would give an ideal comparison, especially in the case of water pipe.

DETAIL NOTES ON CORROSION OF WROUGHT IRON AND STEEL PIPES IN SERVICE LINES

Lot No	Pipe No	Material S. [illegible] W. I. Wrought Iron	Approx. [illegible] Gauge	Pipe [illegible] Diameter	Length of Time Installed	[illegible]	[illegible] Service	Depth of Deepest Pits in Inches	General Condition	[illegible]	
1	/	S	2"	3"	4-5 Yrs	Pre[illegible]	Hot Water	112 111 [illegible] [illegible]	[illegible] pitted all over	12[illegible]	
	..	W. I	2"	3"	4-5 Yrs	[illegible]	Boiler Feed	[illegible]	Failed at [illegible] at [illegible] at one end Rest fairly good	100	
2	[illegible]	S	2"	3"	7½-8 Yrs	[illegible]	[illegible] Water	096 076 .069 ..	Pitted all over	48	
		W. I	2"	3"	7½-8 Yrs	[illegible]	[illegible] Feed	109 106 105 ..	Pitted all over Several [illegible]	100	
3	2	S	210"	2½"	2 Yrs	Pre[illegible]	[illegible]	[illegible] 076	[illegible]	72	Av = 75
	3	S	2[illegible]"	2½"	2 Yrs	Stea[illegible]	[illegible]	[illegible]	[illegible]	77	
	1	W. I	1[illegible]"	2½"	2 Yrs	[illegible]	[illegible]	[illegible]	[illegible]	100	
4	9	S	11[illegible]"	1½"	2 Yrs	. .	[illegible]	[illegible]	[illegible]	[illegible]	Av. [illegible] = [illegible] Taking [illegible] gauge
	8	W. I	11[illegible]"	1½"	2 Yrs		[illegible]	[illegible]	[illegible]	[illegible]	
	-9-	S	11[illegible]"	1½"	2 Yrs		[illegible]	[illegible]	[illegible]		
Note	-9- [illegible] other end of No. [illegible]										
5	10	S	[illegible]	1½"	2 Yrs	. .	[illegible]	[illegible]	[illegible]	[illegible]	
	11	W. I	[illegible]	1½"	2 Yrs		[illegible]	[illegible]	[illegible]	100	
6	18	S	[illegible]	4"	2 Yr 6 Mo		Hot Water	[illegible]	[illegible]	[illegible]	
	1[illegible]	W. I	[illegible]	4"	[illegible]		[illegible]	[illegible] 175	[illegible]	100	
Note	[illegible]										
7	2[illegible]	[illegible]	[illegible]	4"	2 Yr 6 Mo		[illegible]	[illegible]	[illegible]	[illegible]	Taking failure to [illegible] as [illegible] = original gauge
	24	W. I.	[illegible]	4"	2 Yr 6 Mo		[illegible]	[illegible]	[illegible]	[illegible]	
8	33	S	1[illegible]"	2"	2 Yr 2 Mo		[illegible] Boiler Feed	[illegible]	[illegible]	81	
	34	W. I	1[illegible]"	2"	2 Yr 2 Mo		[illegible]	[illegible]	[illegible]	[illegible]	
9	36	S	1[illegible]"	3"	2 Yr 2 Mo	. .	Hot Water [illegible]	[illegible]	[illegible] pitted [illegible]	38	
	35	W. I	[illegible]	3"	2 Yr 2 Mo		[illegible]	[illegible]	[illegible]	100	
10	38	S	2[illegible]"	4"	[illegible]	. .	Hot Water Boiler Feed Horizontal	[illegible] 106	Very bad pits in areas [illegible]	82	
	37	W. I	2[illegible]"	4"	[illegible]			[illegible] 04[illegible]	[illegible]	100	
11	39	S	217"	4"	1 Yr 2 Mo	. .	Hot Water Boiler Feed Horizontal	[illegible]	[illegible]	71	
	40	W. I	*	4"	1 Yr 2 Mo			086 082 [illegible] 07[illegible]	[illegible]	100	
*Slightly heavier than No. 39											
12	42	S	160"	2"	1 Yr 11 Mo	. .	Hot Water Boiler Feed Horizontal	125 109 [illegible]	[illegible]	[illegible]	Taking average of deepest pits of the two [illegible] and of the two [illegible]
	43	S	160"	2"	1 Yr 11 Mo			119 11[illegible] 084 [illegible] 09[illegible]	[illegible]	..	
	44	W. I	150"	2"	1 Yr 11 Mo			[illegible]	[illegible]	[illegible]	
	45	W. I	153"	2"	1 Yr 11 Mo			[illegible]	Several more pits [illegible] Could not measure		
				Exact positions of each piece [illegible]			[illegible]				
13	49	S	246"	2½"	6-9 Mo	. .	Hot Water Boiler Feed Horizontal	[illegible]	Rough surface with hard scale Fair size pits all over		Impossible to measure pits of Nos. 49 and 50 accurately
	50	W. I	252"	2½"	6-9 Mo	. .	Hot Water Boiler Feed Horizontal	[illegible]	[illegible] pits Rusted uniformly all over [illegible] pitting		
	51	S	270"	2½"	6-9 Mo	. .	Hot Water Boiler Feed Horizontal	090 081 080 080 [illegible]	Bad pits in several areas		
14	52	S	310"	4"	6 Mo	. .	Hot Water Boiler Feed Horizontal	[illegible] 091 [illegible] 084 [illegible]	Fairly bad pits scattered all over	72	
	53	W. I	310"	4"	6 Mo.			120 121 118 11[illegible] [illegible]	Bad pits all over	100	
15	28	S	149"	2"	4 Yrs		Hot Water Boiler Feed	[illegible] 088 039 Other slight pits	Fairly bad in several areas Rest protected [illegible]	1[illegible]	
	29	S	132"	2"	4 Yrs		Hot Water Boiler Feed	112 1[illegible] [illegible]	[illegible] pitted [illegible]		
	26	W. I	1[illegible]"	2"	4 Yrs		Hot Water Boiler Feed	[illegible] 059	[illegible] pitted [illegible]		
	27	W. I	1[illegible]"	2"	4 Yrs		Hot Water Boiler Feed	[illegible] 084 [illegible]	[illegible] pitted [illegible]		Taking average of deepest pits of two [illegible]
	30	W. I	1[illegible]"	1½"	4 Yrs		Hot Water Boiler Feed	11[illegible] 1[illegible] 106 [illegible] 076	[illegible] of very bad pits in places		
	31	W. I	175"	1½"	4 Yrs		Hot Water Boiler Feed	114 1[illegible] 1[illegible] 1[illegible]	[illegible] of very bad pits in places	100	
	32	W. I	147"	2"	4 Yrs		Hot Water Boiler Feed	[illegible] 088 [illegible]	[illegible] pitted in several areas Rest [illegible]		

Note. These pipes [illegible] when [illegible] was removed, and there was no way of telling what position these pipes [illegible] or how [illegible] had been used.

Lot No	Pipe No.	Material S-Steel W I Wrg't Iron	Approx Original Gauge	Pipe Size Diameter	Length of Time Installed	Approx Portion of Time Installed That Line Was Used	Character of Service	Depth of Deepest Pits In Inches	General Condition	Percentage Depth of Deepest Pits Wrought Iron Taken as 100%
16	67	S		1"			Horizontal Cold Water Line in Hot House		No. 66 was more pitted than No. 67, but both pieces bent so impossible to measure pits accurately. Neither affected very seriously.	
	66	W. I.		1"						
17	54	S	297"	3"	1 Yr 3½ Mo	Pretty Steady	Hot Water, Boiler Feed Horizontal	100 100 096 096 085	Area covered with pits on No. 54 a little less than on No. 55	87
	55	W I	309"	3"	1 Yr 3½ Mo			115 105 102 099 093		100
18	57	S	286"	3"	1 Yr 3½ Mo	- -	Hot Water, Boiler Feed Horizontal	118 111 104 104 097	Pitted all over	111
	56	W I	303"	3"	1 Yr 3½ Mo			106 104 099 095 090	Pitted through to lamination at one end, impossible to measure. Bad pits all over	100
19	60	S	307"	3"	1 Yr 3½ Mo	- -	Hot Water, Boiler Feed Horizontal	121 122 120 114 111	Very badly pitted in areas	95
	59	W I	317"	3"	1 Yr 3½ Mo			129 124 124 .116 103	Very badly pitted all over	100
20	65	S	313"	3"	1 Yr 3½ Mo	- -	Hot Water, Boiler Feed Horizontal	127 120 114 111 111	Bad pits scattered	117
	66	W I	315"	3"	1 Yr 3½ Mo			109 098 092 085 082	Very badly pitted all over	100
21	67	S	287"	3"	1 Yr 3½ Mo	- -	Hot Water, Boiler Feed Horizontal	089 088 088 087 068	Fairly bad pits all over	82
	66	W I	315"	3"	1 Yr 3½ Mo			109 098 092 085 082	Very badly pitted all over	100
										Average of percentages (Lots Nos. 13 and 16 not included) Steel, 99% Iron, 100% (Depth of pitting in Wrought Iron taken as 100)



A TEST OF STEEL AND WROUGHT IRON PIPE UNDER COMPARATIVELY EQUAL CONDITIONS

Let us consider for a moment the results of a study of pipe removed from hot-water supply lines in the New York City baths which was undertaken by Prof. Ira H. Woolson, formerly of Columbia University, now consulting engineer of The National Board of Fire Underwriters.* Briefly, he found that out of 86 pieces in eight bathhouses, which had failed through corrosion, 23% were wrought iron, a larger proportion than might be expected, judging by the relative proportion of wrought iron to steel on the market. In cases where pieces of iron and steel were removed from the same line they were found to be equally corroded. The samples shown are cases in point.

We recently had an opportunity to examine the boiler feed-water pipe at the mines of the Frick Coke Company, which had been giving trouble in this way. Means were found to identify the pipe without removing it from the system. As anticipated, we found a number of cases where wrought-iron and steel pipe had been put in together. Samples of such pieces were removed and cut open for examination. The results of corrosion were expressed in terms of the depth of the deepest pits as was done by Mr. T. N. Thomson in his interesting experiments in hot-water service lines. The results, so far as completed, are given in the table on Page 24.

Generally speaking, these figures and inspection of the interior of these pipes show that there would be nothing to gain by using wrought iron. A similar case of comparison in a cold water line was found is a greenhouse near Pittsburg with the same results. (Nos. 66 and 67, same table.)

A CASE OF CORROSION OF HOT WATER PIPING

We recently had an opportunity to investigate the piping in an apartment in New York City where they were having trouble with the leaking of hot water lines which had been in service about six years. The second or third piece examined proved to be wrought iron and was found in the condition shown. The other sample taken from the system through which the same water had been continually circulated illustrates how the steel was affected. This intermixture of iron and steel pipe can be explained by accidental intermixture in the manufacturers' or jobbers' stocks, and appears to be quite general.

PREVENTION OF CORROSION IN PIPES

If the trouble is not due to the material, why is corrosion so much more serious nowadays, and how can conditions be bettered?

Going back to the principal factor in corrosion, viz., the air dissolved in water, it has been found that oxygen is more soluble than nitrogen, so that the proportion of the two gases in solution is about two volumes of nitrogen to one volume of oxygen, instead of five of nitrogen to one of oxygen as in the atmosphere. Pure water at normal pressure will dissolve 14.7 parts per million of oxygen at 32° F. and 7.60 parts per million at 86° F. At 210° F. oxygen is practically insoluble.

So by heating the water the solubility at normal pressure becomes less, but as water is usually heated in closed heaters under pressure the gases are forced to remain in solution and in this condition the water may be said to be supersaturated. It is quite possible that in this state the oxygen is more active; the more so the higher the pressure. On drawing off hot water from such a line into a glass the gas is released and may be readily seen. Experiments have shown that under normal pressure water and air are most active in corrosion between 140 and 180° F.

Evidently, then, if, as is the case, much more hot water is being put through service lines (particularly in large hotels, apartment houses and factories) today, we must expect a proportional increase in corrosion; so that, if three times as much hot water is being run through a pipe of given size under the same pressure and temperature, the pipe, instead of lasting twenty-one

*Engineering News, December 8, 1910.

years, will only last about seven years.

Knowing, as we now do, something of the cause and principles of prevention of corrosion, it should be possible for engineers to do much to remedy this state of affairs. Apparently there is as little need of corrosion in pipes and tubes around boilers and in hot water heating and supply systems as there is for smoke from a modern power plant. The author is now trying out a system for removing dissolved gases from water by heating the water to a sufficiently high temperature, preferably under normal atmospheric pressure or a vacuum, and then cooling if necessary by passing the air-free water through a form of economizer designed like a closed feed water heater in which the excess heat in the air-free water is taken up by the cold feed on its way to the heater. This provides for a continuous supply of air-free water for service lines at any temperature. The treatment may with advantage be carried out on the roof slightly below the level of the cold water standpipe. Another scheme for accomplishing the same purpose was proposed by the Royal Commission appointed to investigate the cause of corrosion in the Coolgardie (Australia) water supply main. They found after a thorough study of the situation that the conduit was suffering on account of oxygen dissolved in the water, and recommended that the supply be sprayed into vacuum chambers with the addition of 3 grains of lime to the gallon before passing into the pipe. A plant was designed for this purpose on the principle of a barometric condenser.*

The addition of ferrous sulphate and some alkali to water filtering off the hydrate of iron before the water enters the line has been found quite effective in removing oxygen from solution. By rendering the water slightly alkaline before passing into the pipes corrosion may be greatly lessened even though free oxygen is present. In many cases however, this would interfere with the use of the water for certain purposes.

Doubtless other means will be found to remedy the trouble when the economic importance of the problem is fully realized by engineers. Elaborate plants are provided for treatment of boiler water, which pay for themselves in a few years many times over, but so far in this country we continue to suffer loss in water lines and as a rule the responsibility is shifted onto the pipe manufacturer. Not that pipe cannot be improved, for steel pipe is now being made which is much better than that put out ten years ago, and even superior in lasting quality to the much-talked-of brands of wrought iron. Protective coatings more suitable for modern conditions are also possible, but why not endeavor to apply the obvious remedies and remove the fundamental cause of the trouble?

*Engineering Record, May 21, 1910.

Tight Storm Windows a Cause of Disease

That West Duluth, Minn., is a hotbed for tuburculosis, and that this is caused from the fact that the people in this part of the city use improper methods in ventilating their homes during the winter months is the statement made by Mrs. Florence Lee, visiting nurse for the State Anti-Tuberculosis Society.

Mrs. Lee states that the western end of the city has more tuburculosis cases than any other part of Duluth. An investigation made by her recently revealed the fact that the cause of most of this was from the use of the wrong kind of storm windows.

These storm windows, Mrs. Lee says, are, in the majority of cases, nailed on tight early in the fall and from then on until late in the spring the rooms receive no pure air. The small slit which is furnished in some of the windows for the purpose of giving ventilation is inadequate to properly allow the fresh air to circulate in the rooms.

She advocates the use of storm windows which may be swung out from the top and keeping open all the time with the exception of possibly the coldest of weather.

Is the CO_2 Air Test a Fallacy?

A CORRECTION

So much interest has been aroused by the description, in THE HEATING AND VENTILATING MAGAZINE for February, of tests recounted by Dr. Luther H. Gulick, in which human beings were confined in highly vitiated atmospheres, that we take pleasure in presenting herewith a view of the respiration calorimeter laboratory at Wesleyan University, in which many of the experiments were made.

The correct size of the respiration chamber itself is 7 ft. 6 in. long, 4 ft. wide and 6 ft. 6 in. high. It will, therefore, be seen that the chamber contains 197.60 cu. ft. of air space, which is somewhat reduced by the inside furnishings, including a chair, table and bed, all of which could be folded and put aside when not in use.

It should also be stated that the air supply in the various tests, which is expressed in liters, may be read in cubic feet by figuring a liter as 61 cu. in. or 0.0352 cu. ft. Thus, the supply of air in many of the experiments, which was mentioned as 100 liters per minute, would be equivalent to 3.52 cu. ft. In another case, where the supply was reduced from 100 to 75 liters, it would be equivalent to from 3.52 cu. ft. to 2.62 cu. ft. per min. In a third case, where the supply of air was reduced to 55 liters, it would be equivalent to 1.92 cu. ft. per minute, which was the smallest figure reached.

The Heating of Portable Buildings

A system of heating and ventilation has been installed in the portables and annexes of the school buildings throughout Everett, Wash., and now these one-room buildings, which have been heretofore a menace to the health of pupils, are as well heated and ventilated as the best of the large systems. The twenty plants installed were made by the Smith Heating works of Milwaukee. They consist of a large round steel asbestos lined shield which encloses a regular coal stove, while from the outside is connected a fresh air pipe through which cold fresh air passes, entering a distributing hood in the bottom of the shield

GENERAL VIEW OF RESPIRATION CALORIMETER LABORATORY AT WESLEYAN UNIVERSITY. RESPIRATION CHAMBER ON THE RIGHT

which forces the air to come in contact with the heat from the stove, and in this way the air thus heated is distributed through the room.

On the stovepipe is arranged a mixing dome with a large ventilation pipe which, by an elbow, extends nearly to the floor. By the draft of the stove a strong suction is formed so that the foul air is drawn from the floor and goes out through the chimney. Another convenience is that the stove will now take up less room and may be placed in a dark corner, giving the lighted portion of the room to the pupils.

Infected Milk May Be Caused by Poor Ventilation

It is a well known fact that there is a crusade now being carried on against infected milk, through tuberculosis in cattle. If it is necessary for *humanity* to have a proper amount of air to withstand disease, then *cattle* should have it too, as they provide food in the early stage of life, and the very existence of our country depends upon how our children are brought up; your duty therefore, is, to *attract the public* as much as possible by putting before them the absolute necessity of a proper system of ventilation and heating.—JOHN H. HAZZARD, *before the British Institution of Heating and Ventilating Engineers.*

Philadelphia's Director of Health Urges Ventilation for Prevention of Pneumonia

Dr. Neff, Philadelphia's director of health, believes in keeping his department constantly in the public eye. He is out with a circular detailing the dangers of pneumonia and telling how to prevent it. "Ventilation is the keynote of prevention from pneumonia, whether in office, public building, sitting room or bed-room," says Dr. Neff. "Day and night pure air should be breathed. The old superstition that the breathing of night air is conducive to disease has been eliminated from the minds of nearly all by public education, with the exception of a few of our foreign population, who still believe that some diseases are spread by the breathing of night air. As a matter of fact the night air is purer than the day air, as there is less black smoke belching from chimney stacks and locomotives and less dust in the air, owing to reduced street traffic; so windows should be opened both top and bottom in every sleeping room."

Fresh Air Reduces Death Rate

In the weekly bulletin of Chicago's health department, it is reported that in October, 1909, 381 persons were killed by pneumonia. In October of this year, 247, a saving of 134 deaths. This would indicate that the department's teaching and preaching as to the danger of dirty air are bearing fruit. It means that some people are learning that it is better to ventilate than to hibernate. They are beginning to understand that the druggists have no remedies in stock that are as good for maintaining bodily health and vigor as fresh, pure air.

Radical Legislation Proposed to Ventilate Closed Rooms

The following bill was introduced in the last Indiana legislature by Henry M. Williams, of Fort Wayne, Ind.:

"Be it enacted, etc., etc., that on and after four years from the date of the passage of this act it shall be unlawful to construct any room, with floors and windows that can be closed in any building designed for human habitation unless the same be provided with an outlet opening on the floor or in the baseboard next the floor, in size proportioned to the cubic contents capacity of the room to be determined by the board of health of the state of Indiana, the said outlet opening to be connected directly or indirectly with the outdoor air."

The subject was introduced by Dr. John Guerin, the original advocate of "open-air" schoolrooms.

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WE TAKE pleasure in announcing the publication, commencing in the April issue, of a series of articles on the subject of central station heating. These articles will cover every important phase of this subject, which has thus far received remarkably scant attention in the way of published data. Indeed, there is no one publication to be had which attempts to cover all of even its more important phases, and it is in an endeavor to remedy this deficiency that the forthcoming series of articles, dealing with present-day practice in central station work, has been prepared. The articles will be from the pen of Byron T. Gifford, of Chicago, whose experience in this field of engineering qualifies him to a marked degree to speak authoritatively on this important subject. The first article by Mr. Gifford, which will appear in the April issue, will discuss, in a new and thoroughgoing manner, the matter of pipe sizes in central station heating work.

REPORTS from Chicago indicate that that busy city is likely to be the scene of important developments in the steam fitting trade in the near future. The sequence of news already available may be summed up as follows:

The formation of a "major heating league" in the State of Illinois by master steam and hot water fitters to secure better trade protection.

A formidable movement on the part of the International Union of Journeymen Plumbers to disrupt or absorb the International Union of Steam Fitters in Chicago.

The largest meeting since its organization of the Chicago Association of Heating and Ventilating Contractors and Engineers.

The selection of Chicago as the place for holding the twenty-third annual convention of the National Association of Master Steam and Hot Water Fitters.

The conditions here indicated would seem to be ripe for some constructive work of the first magnitude in regard to the bettering of trade conditions in the Middle West. No doubt a determined effort will be made to bring about closer harmony in the trade, but the question is, will the old mistakes be repeated and the negotiations split on the rock of ultra conservatism on the part of the East versus ultra radicalism heretofore imputed in this connection to the West? It is safe to say that only by overlooking past differences and by approaching the subject through new men and new measures can any permanent degree of progress be attained in the furthering of the association idea in this particular direction.

Annual Meeting of British Heating Engineers

The annual general meeting of the (British) Institution of Heating and Ventilating Engineers was held in London February 14, with the retiring president C. Ingham Haden in the chair. Among those in attendance was Theodore Weinshank, of Indianapolis, a member of the American Heating Engineers' Society. Mr. Weinshank addressed the meeting on the subject of ventilation.

On assuming office the new president, O. M. Row, M. I. Mech. E., of Irlam, Manchester, delivered his inaugural address in which he said:

"I take it as a main principle that hot water radiation is the best for hygienic purposes, and of course there are many ways of applying the heat, namely, by means fuels, coal, coke, gas, steam, but let the heated water be the only direct medium by either natural or forced circulation.

O. M. ROW
[illegible]

"Ventilation and plenty of it is of the utmost importance, but I am seriously under the impression that such ventilation as a large green box, with only three sides, out on the green sward, and exposing delicately constituted people to the rude atmosphere of our climate is cruelly wrong.

"I hear people talk of cold bedrooms, open windows, wind and rain (and sometimes snow) blowing across their beds and freezing their eye lashes, etc. This is all nonsense, (if one may be forgiven such an expression); give me a good radiation from hot water surface, and then plenty of properly disposed inlet and outlet vents, and my night's rest is perfect and health giving. People in this country seem frightened almost to death at a bit of first cost, which often means a permanent economy and comfort.

"I think we may look hopefully for a closer and very sympathetic connection between the old country and our brothers of the colonies of the Empire, our cousins of the United States of America, and all English speaking people, and all that is possible should be done to establish interchange of ideas which will broaden our minds and strengthen our knowledge."

A paper was read by John H. Blizard, A. M. Inst. C. E., F. R. I. B. A., of Southampton, on "The Ventilation and Heating of Public Buildings in Their Relation to the Prevention of Tuberculosis." This was followed by an address given by W. H. Hurtley, D. Sc., of St. Bartholomew's Hospital, London, on "The Air of Inhabited Rooms With Special Reference to Dust" and a "Case of Corrosion by Water of the Hot-Water Pipes at a Sanatorium."

The dates of future meetings were fixed as follows:

Summer meeting at Chester, July 3 and 4.

Autumnal meeting, October 17, at the Institution of Mechanical Engineers, Storey's Gate, London, S. W.

Annual meeting, London, on February 6, 1912.

The usual dinner followed the general meeting and a very enjoyable evening was spent.

The new president, Oliver M. Row, M. I. Mech. E., joined the institution as a member in 1902. In 1881, at the age of 22 years he became manager to Hocking and Company, Limited, of Liverpool, distillery and heating plant manufacturers. While there Mr. Row developed his interest in the problems attaching to the distillation of water for drinking purposes, bringing out several patents connected with this and similar work. Notable among his inventions is the "Row tube," perhaps the most effective type of tube yet invented for steam heating purposes. Later, Mr. Row took over the business himself, afterwards coming to Manchester, where, in conjunction with Mr. J. J. Royle, was started the Irlam works of Royles, Ltd.

In 1906 Mr. Row was awarded the silver medal of the Institution of Heating and Ventilating Engineers for the paper on "The Uses of Steam for Heating Purposes," and a bronze medal was awarded to him at the Franco-British Exhibition in 1908 for his contribution of apparatus for "Heat Transmission."

Current Heating and Ventilating Literature

Under this heading is published each month an idex of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

FAN BLAST HEATING

Design of Fan Blast Heating. H. C. Russell. Gives data on the proportioning of heating apparatus for factories, schools and public buildings. 2000 w. Met Work.—Jan. 21, 1911. Serial. 1st part. 20c.

PIPE SIZES

Deduction of a General Formula for Determining the Most Economic Size of Pipe to Carry Pumped Water. Shows a simple rule closely applicable under wide variations of pipe, fuel and pump costs. 4000 w. Engng-Con. Jan. 25, 1911. 20c.

[illegible]

Design of Steam Power Plants. William F. Fischer. Discusses the factors to be considered. 2000 w. Power—Jan. 24, 1911. [illegible]

STEAM PIPING

A Simple Method of Determining Sizes of Pipes for Low-Pressure Steam-Heating. F. E. Giesecke. Diagrams and explanation, illustrated by problems, and giving related information. 3500 w. Dom Engng—Jan. 14, 1911. 20c.

[illegible]

Modern Steam Superheaters. Warren O. Rogers. General illustrated description of American superheaters, dealing with features of design and application. 3500 w. Power—Jan. 3, 1911. 20c.

[illegible]

Mechanical Ventilation. J. Radcliffe. Based on a paper read before the Heat & Vent. Engrs. Discusses the requirements of a perfect system of ventilation and means of attaining the desired results. [illegible] Jan. 6, 1911. [illegible]

Proposed Factory Ventilation Law for Wisconsin

Through the activity of the Wisconsin State Federation of Labor a bill has been introduced in the Assembly by Mr. Vint, relating to the ventilation of manufacturing and mercantile establishments. The bill was referred to the Committee on Labor and Labor conditions. Following is the full text of the measure:

"Section 1. There are added to the statutes three new sections to read: Section 1636-32l. In factories, mills, workshops, mercantile or mechanical establishments, the windows shall be so arranged that they will permit of the circulation of fresh air from the outside of the building at all times, and shall be so constructed as to prevent direct drafts from striking the employees working therein. Where the circulation of fresh air cannot be satisfactorily secured through an arrangement of the windows, any system of ventilation that will keep the air therein free from substances and qualities injurious to the health or comfort of the employees, either by fans, suction devices and the like, which shall be approved by the bureau of labor and industrial statistics, may be installed.

"Section 1636—32m. Every factory inspector and every assistant factory inspector charged with the inspection of factories, mills, workshops, mercantile or mechanical establishments, shall investigate the system of ventilation in every plant inspected, and wherever same is not found to comply with the provisions of this act, notice thereof shall be given to the owner or owners thereof, or to the officer or officers, if said factories, mills, workshops, mercantile or mechanical establishments be corporations. Whenever the owner or owners of said factories, mills, workshops, mercantile or mechanical establishments, or officer or officers of said plants do not take steps to remedy the system of ventilation, after due notice of defects thereof has been given in accordance with the provisions of this act, said owner or owners thereof, or the officer or officers thereof shall be punished by a fine of not less than $25.00 nor more than $500.00, or by imprisonment not less than thirty days, nor more than six months, or by both such fine and imprisonment.

"Section 1636—32n. It shall be the duty of the district attorney of every county in this State to prosecute all violations of this act upon complaint of any officer of the State or any citizen."

Congress of Technology

A congress of technology, at which will be presented a series of papers dealing with the place of science in modern industry, will be held in Boston, April 10-11. The first of these dates is the fiftieth anniversary of the chartering of the Massachusetts Institute of Technology and the primary purpose of the congress is to fittingly mark that anniversary.

The whole body of papers to be presented will constitute a survey of engineering and industrial science as a whole, from a body of men who will speak from first-hand experience with industrial problems.

The papers, separately, will discuss the conditions and prospects in specific industries. No similar discussion of the industries has been attempted on such a scale, and the record promises to be of unique suggestive value to the manufacturers of the country. The meetings will be open to the public.

Lower Express Rates from New York to New England Points

Express rates to and from New York and Brockton, Whitman, Rockland, Taunton, North Attleboro, Mass., and Pawtucket, R. I., have recently been lowered 25 per cent., as the result of an order issued by the Interstate Commerce Commission. This new rate took effect Feb. 6, 1911, and applies to what is known as the "boat and rail line" but which is rail to Fall River and thence by boat to New York. The rate was formerly $1.00 per hundred either by rail or water and now it is 75 cents per hundred; small packages accordingly. To secure this rate it is important to mark all packages "via boat and rail." The new rate, as prescribed by the Interstate

Commerce Commission, is the result of a year's litigation carried on by Mr. Henderson of the National Claim Bureau, and R. J. Donovan, both of 170 Broadway, New York, against the Adams Express Company.

CORRESPONDENCE

The Rating of Boilers and the Use of Fuel Gas

Editor Heating and Ventilating Magazine:

We note with interest the "Rules for Rating Heating Boilers" adopted by the American Society of Heating and Ventilating Engineers. The committee has probably done as well as could humanly be expected, and its members have shown themselves to be men wise in their generation in shifting to the Committee on Tests the burden of specifying as to the nature of the conditions on which tests for efficiency should be conducted. When we consider that testing under laboratory and working conditions are entirely different propositions, and that, in all probability, no maker of heating boilers now on the market would dare to run his boiler under working conditions under the inspection of disinterested scientific observation, and that we have still to hear that any boiler maker has attained the angelic status of running his business for the general public good, it is fair to infer that said testing committee has had a burden of some weight shifted onto its shoulders, if its findings are to be strictly just, and that it will be some considerable time before such a fair report is made and accepted.

As a matter of fact, the subject of relative efficiencies of boilers will have to be left largely to the decision that will arise from a competitive battle between the manufacturers. It will involve the offer of one or more makers having faith in the quality of their products, backed up by enough cash to make a demonstration, to submit to any fair test under disinterested observation. As the matter now stands the probable efficiencies of a dozen or more makes of boilers are so nearly equal that it would be a rather poor policy for the more active makers to publish such a fact. Certainly those whose outfits comprise the most efficient line of good salesmen and competent advertisers are not likely to do so.

Nevertheless, it will be a good thing for the committee newly emburdened to work at the problem of the conditions under which tests should be made, for in most boilers there is a continual loss of from 10% to 15% in ash wastes, 15% to 30% in imperfect combustion, and from 20% to 35% in chimney gas loss of untransferred heat. A majority of the boilers have less than 50% efficiency, and, in the meantime, the damage done to health, life and property from smoke is enormously great.

When the world realizes that it is entirely practical to convert into an effective fuel gas over 75% of the heat energy of cheap coals, including soft bituminous, lignite and super-hard grades, that such gas can be burned without smoke, and that that gas can be sold at a good profit at prices from one-half to two-thirds less than the usual selling prices for gas, the smoke nuisance will not be tolerated in any town of over 200 houses.

Among the advances now made have been the development of simple fuel gas making plants suited to small installations. In view of the greatly superior economic efficiency and utilitarian advantages of central fuel gas plants, it becomes obvious that centre steam and hot water systems for heating will have no field outside of those which will be concomitant with utilizing exhaust steam or hot water in power plants. But isolated boilers heated by the fuel gas will be used, because of the weight and bulk of the large amount of heating surface required to secure effective transmission of the heat generated.

One of the most important lessons for the heating and power generating worlds to learn is that to secure economic efficiency in heat transmission, a sufficient area of heating surface must be used. The arrangement of that surface is a secondary matter, but decidedly important. It will also have to be accepted as a fact that a perfect smokeless combustion of the easily volatilized fuels is practically impossible in isolated plants more or less completely burning such fuels under atmospheric pressure in immediate relation to heating surfaces. But with a suitable device, designed for the continuous gasification of the fuel without regard to intermittent feeding of the fuel, a complete volatilization of the fuel into burnable gases, a fixation of the tarry or other vapors in the gases and the prevention of untransformed carbon formation is secured.

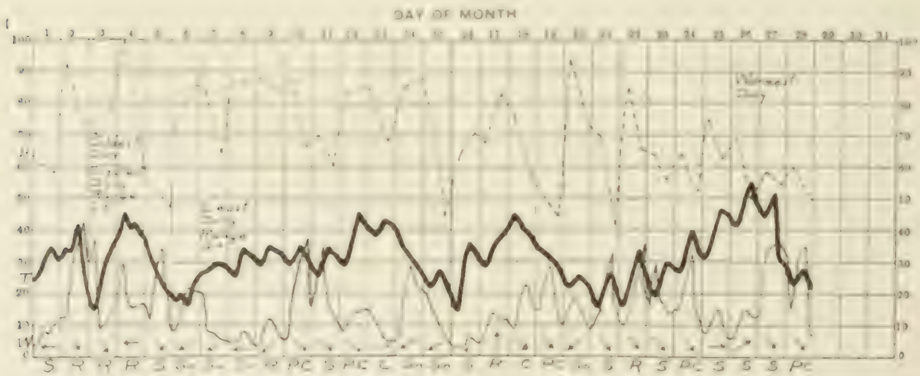
Besides the hygienic and social advantages of generally using a fuel gas in a city like Chicago, the economic savings effected would be something like $200,000 each day. When that recognition is made, the questions of needed areas of grate surface and pound rates of fuel consumption will be of small consequence. The meter measuring the gas will supersede most of the instruments of precision used by the present-day engineers.

J. M. W. Kitchen, M. D.

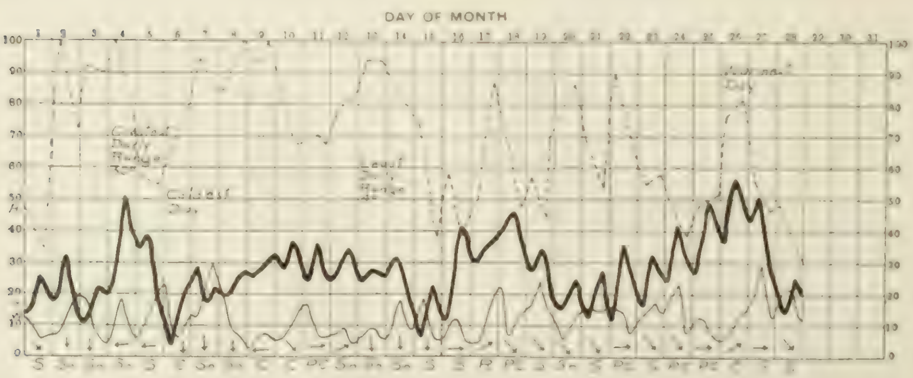
East Orange, N. J.

The Weather for February, 1911

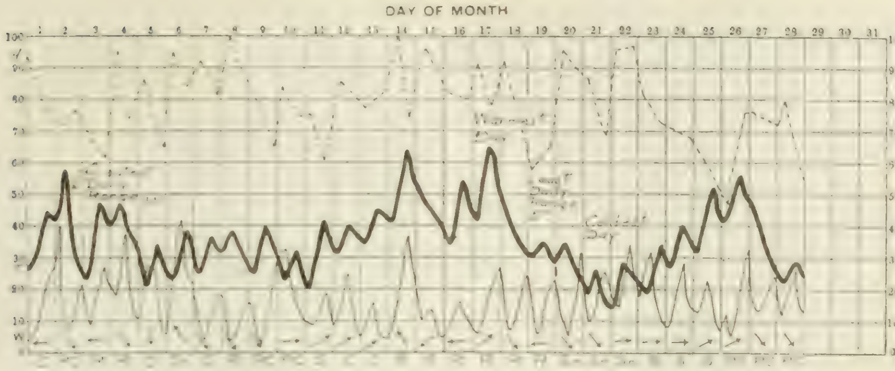
	New York	Boston	Pittsburg	Chicago	St. Louis
Highest temperature, degrees F.	56	[illegible]	64	[illegible]	[illegible]
Date of highest temperature	26	[illegible]	17	17	1
Lowest temperature, degrees F.	13	[illegible]	[illegible]	[illegible]	16
Date of lowest temperature	[illegible]	[illegible]	[illegible]	19	22
Greatest daily range, degrees F.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Date of greatest daily range	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Least daily range, degrees F.	4	[illegible]	5	[illegible]	[illegible]
Date of least daily range	[illegible]	[illegible]	19	[illegible]	12
Mean temperature for month, degrees F.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Normal mean temp. this month, deg. F.	[illegible]	28	[illegible]	25	34
Total rainfall	[illegible]	[illegible]	1.98	2.27	3.02
Total snowfall, inches	[illegible]	[illegible]	[illegible]	10.4	[illegible]
Normal precipitation, this month, inches	[illegible]	3.44	2.66	2.16	2.75
Total wind movement, miles	9416	7856	[illegible]	10518	8403
Average hourly wind velocity, miles	14	11.7	13.4	15.7	12.5
Prevailing direction of wind	N. W.	N. W.	N. W.	S. W.	[illegible]
Number of clear days	6	[illegible]	[illegible]	8	10
Number of partly cloudy days	11	[illegible]	8	5	7
Number of cloudy days	11	[illegible]	[illegible]	[illegible]	11
Number of days on which rain fell	[illegible]	10	13	[illegible]	[illegible]
Number of days on which snow fell	[illegible]	9	4	6	4
Snow on ground at end of month, inches	None	None	None	None	1.2



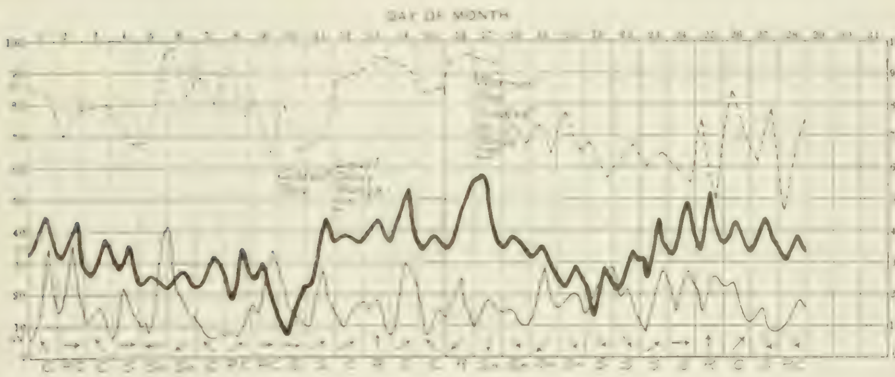
RECORD OF THE WEATHER IN NEW YORK FOR FEBRUARY, 1911



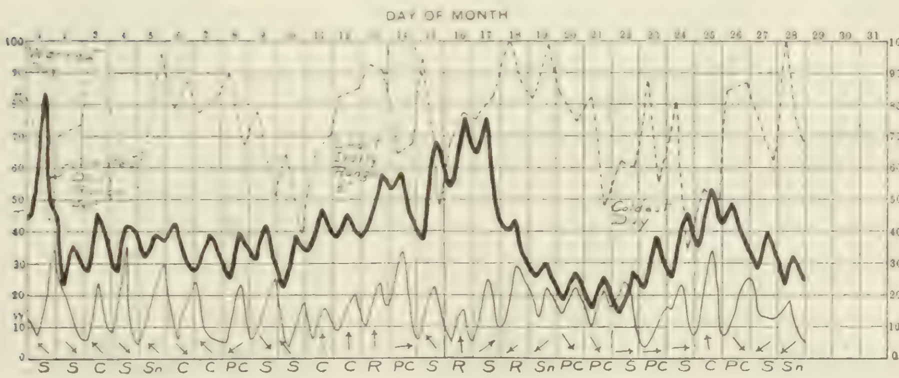
RECORD OF THE WEATHER IN BOSTON FOR FEBRUARY, 1911



RECORD OF THE WEATHER IN PITTSBURG FOR FEBRUARY, 1911



RECORD OF THE WEATHER IN CHICAGO FOR FEBRUARY, 1911



RECORD OF THE WEATHER IN ST. LOUIS FOR FEBRUARY, 1911

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate relative humidity in percentage from readings taken at 8 A.M. and 8 P.M.
S—clear. P C—partly cloudy. C—cloudy. R—rain. Sn—Snow.
Arrows fly with prevailing direction of wind

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Chicago Gets Next Annual Convention

Official announcement has been made that the next (23rd) annual convention of the National Association of Master Steam and Hot Water Fitters will be held in Chicago. The dates selected are June 5-8, 1911. Headquarters have not yet been announced.

Isolated Power Plant Association

At an organization meeting of the National Isolated Plant Association held in the Engineering Societies Building, New York, the following officers were elected: President, Charles G. Armstrong, New York; vice-president, F. E. Styles, New York; secretary, E. D. Fieux, New York; treasurer, W. B. Elliott, New York; council members (in addition to the president and treasurer) J. C. Buxton, D. D. Kimball, S. F. Ferguson, Henry Katteen, and L. B. Elliman, all of New York. The object of the association as stated in its constitution, which has been adopted, is to foster interests of isolated power plants throughout the United States and the interests of those engaged in the design, construction, operation and ownership thereof. The initiation fee is placed at $[illegible] and annual dues at $[illegible], except for operating engineers, who pay $5 initiation fee and $2 a year dues.

An annual meeting is to be held on the fourth Monday of January and monthly meetings on the last Monday of each month.

NEW DEVICES

A New Fire Governor

A new automatic fire governor for stoves and furnaces, and for which is claimed a saving of from 30 per cent. to 60 per cent. of fuel, anthracite or lignite, has been designed by an engineer of Washington, D. C. The characteristic mechanical feature of the damper is its simplicity, each part, of which there are six, is stamped from sheet metal in sizes suitable for pipes ranging from 5 in. in diameter upwards.

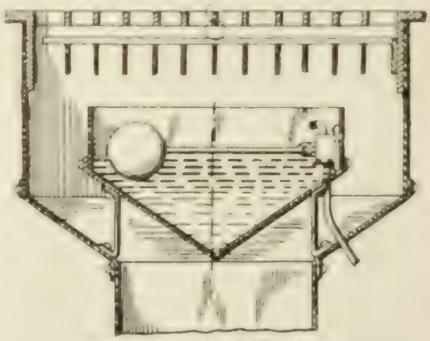
It is operated entirely by the draft, which, as is well known, increases as the heat increases. By its use a fire may be lighted, and without further attention left to control itself. The damper will turn off when the desired temperature is reached or will open the draft, proportionately, should the fire drop a degree or two. In this manner a uniform heat to suit any climate is accurately obtained.

NEW TYPE OF AUTOMATIC FIRE GOVERNOR

The life of the governor is estimated to be about five years. It can be applied to any pipe in a few moments, and in tests has proven practicable. J. V. Robinson of Washington, D. C. is the patentee.

A Register Humidifier

The location of a humidifying device in the casing of a hot air register is a scheme lately patented by George Griffin Lewis, of Syracuse, N. Y., and shown in the accompanying illustration. It will be



REGISTER HUMIDIFIER

noted that a water reservoir, with a downwardly tapered bottom, is placed in the casing which has a corresponding taper, thus permitting an air flow all around the water reservoir. A water supply pipe is connected to the reservoir, bridging the space in the casing. The water level in the reservoir itself is controlled by a float valve.

TRADE AND MISCELLANEOUS NOTES

Coming Events

May 30-June 2, 1911. Spring meeting of The American Society of Mechanical Engineers at Pittsburg, Pa.

June 5-8, 1911. Twenty-third annual convention of the National Association of Master Steam and Hot Water Fitters, at Chicago, Ill.

June 6-8, 1911. Third annual convention of the National District Heating association at Pittsburg, Pa. Headquarters will be at the Fort Pitt Hotel.

June 13-15, 1911. Annual convention of the National Association of Master Plumbers, Galveston, Texas. Headquarters at the Hotel Galvez.

Deaths

Louis R. Alberger, president of the Alberger Condenser Co., and the Alberger Pump Co., New York, died Jan. 31 at him home in New York. He was 47 years old. Mr. Alberger was for thirteen years superintendent of the condensing department for Henry R. Worthington. He incorporated the Alberger Condenser Co. in 1901. He was one of the best-known specialists in the country in his line. He is succeeded as president by George Q. Palmer, formerly vice-president, while D. H. Chester has been elected vice-president of the Alberger Condenser Co., and W. S. Doran, vice-president of the Alberger Pump Co.

Mrs. A. Fredericka Mueller, widow of the late H. Mueller, founder of the H. Mueller Mfg. Co., Decatur, Ill., died Jan. 26, of cerebral apoplexy, in her 72d year. She is survived by five sons who compose the well-known heating and plumbing manufacturing firm established by their father.

Col. George D. Scott, the first president of the National Association of Master Plumbers, died Feb. 18 at his home in Brooklyn. He was 75 years old.

Miscellaneous Notes

Durham, N. H.—Prof. C. E. Hewitt, of the department of electrical engineering at the State College, has been engaged to report upon the feasibility of the bill introduced by Representative Couch of Concord, which provides for the erection and equipment of a central heat and lighting plant for the State House, state library and the New Hampshire Historical Society building. The bill covers an appropriation of $55,000.

Defiance, O.—An ordinance to grant the Defiance Gas & Electric Co. the right to use the city streets in laying out a central heating system was laid on the table at a recent meeting of the City Council. The company agreed to give heat to the city hall to the amount of $250 a year at the regular rates for such services as a consideration for the franchise.

Minneapolis, Minn.—A central heating plant is being considered by the Greenview Improvement Association, whose district extends from Morgan to Girard Ave. south from Franklin, north to and including Mount Corve. John A. O'Brien is chairman of the committee investigating the subject, the other members being C. [illegible] and Anton Knoblauch.

Sioux City, Ia.—Plans for a new car heating and cleaning plant for the Northwestern Railroad, to cost several thousand dollars, have been drawn, and it is expected that work will begin soon.

Monticello, Ia.—Work on the new central station heating plant for Monticello will begin in the Spring.

Elgin, Ill.—Plans for a $500,000 stock company to supply the business district of Elgin with steam heat from a central plant have been launched by Henry Muntz of that city. Mr. Muntz has already purchased the old power house at River street and Dexter avenue from the traction company for $10,000.

Baltimore, Md.—The consolidation is reported of the Baltimore Refrigerating and Heating Co. with a number of local ice companies, with an increase in capital stock of $[illegible].

Anderson, Ind.—An application has been made to the City Council for a franchise for a new steam heating company. It is proposed to surrender the franchise now held by the Home Heating Co. The new franchise will ask for the privilege of covering all territory between the C. W. & M. branch of the Big Four and the Pennsylvania Railroad from east to west and between Sixth and Fourteenth streets from north to south.

Kokomo Railway & Light Co., Kokomo, Ind., has filed notice of enlarge-

ment of purpose to enable the company to operate a steam heating plant. G. J. Marott is the president.

Dexter, Ia.—The people of this city will soon vote to determine whether a gas plant shall be installed for heating, cooking and lighting purposes.

Oakland, Cal.—A central heating plant to cost $100,000 is about to be established in Oakland by the Oakland Gas, Light & Heat Co. Work is already under way, the necessary permits having been recently granted by the Oakland Board of Works. The system will cover many of the city's principal streets and will be one of the most important undertakings of its kind in the Far West.

Edward Blake, Jr., until recently manager of sales for Wells Bros. Co., Greenfield, Mass., makers of pipe threading tools, has resigned to take the management of the Canadian Tap Die Co., Ltd., Galt, Ont., of which ne has been treasurer since 1905. Mr. Blake holds a controlling interest in the Canadian concern.

Prof. John R. Allen, of Michigan University, has been elected vice-president of the Michigan Engineers' Society, at its recent meeting in Lansing.

Buffalo, N. Y.—On invitation of the Department of Research of the American Radiator Co. a visit was made recently to its testing plant at Buffalo by a committee from the National Association of Master Steam and Hot Water Fitters in connection with its investigation of the question of ratings for house heating boilers. Included in the party were: Vive-president Denny, of Newark, and Messrs. John T. Sadler, John W. Danforth, Gombers, English, Bishop, Baldwin and Cryer of the Standardization Committee.

Cincinnati, O.—Sanitary policemen have been stationed at Fountain Square to see that the street cars are properly ventilated. The suggestions of the health department have been ineffective on some of the city's street lines.

Harrisburg, Pa.—A local association of master steam and hot water fitters has been organized at Harrisburg. At the present writing the new organization is an independent body. President, William Jennings; vice-president, C. Fisher; treasurer, Warren Bossler; secretary, H. B. Low. For the present regular meetings will be held at the plant of the Harrisburg Steam Heat & Power Co.

Richard D. Kimball Co., Boston and New York, heating and ventilating engineers, announces the removal of its

New York offices to 15-17 West 38th street. Its testing and inspection department has been removed to the same address.

Percival Robert Moses, consulting engineer, announces the removal of offices to 366 Fifth avenue, corner of Thirty-fifth street. The Engineering Supervision Company has removed to the same address.

Isolated Plant, New York, announces the removal of its executive offices to 366 Fifth avenue.

American Society of Mechanical Engineers will hold its spring meeting in Pittsburg May 30-June 2, inclusive. The society has not met in that city since 1884. There are now about 160 members in the Pittsburg district. Arrangements for the forthcoming meeting are in the hands of an executive committee consisting of E. M. Herr, George Mesta, J. M. Tate, Jr., Chester B. Albree, D. F. Crawford, Morris Knowles and Elmer K. Hiles, secretary.

United Bunch of Sheep, home fold, at its recent annual meeting in Milwaukee, Wis., elected the following officers for the ensuing year: Grand ram, A. M. Wagner; vice-ram, Richard Hohnbach; grand shearer, George Roska; keeper of the golden fleece, Fred Wagner; shepherd, Arthur Wellhausen; director for one year, U. B. Garnsey; director for three years, F. E. Nolan. Fifty members were in attendance. Plans were reported for organizing branch folds in Minneapolis, St. Paul, Detroit and St. Louis. Although hardly three years old, this unique organization of salesmen has attained a strength, both in numbers and influence.

Springfield, Ill.—At a meeting held recently in Springfield, according to *Domestic Engineering*, a major heating league was formed in conjunction with minor heating leagues already formed in the state of Illinois for the purpose of securing better trade protection for the steam heating contracting trade. T. E. Walters, Aurora, was elected president of the league; J. E. Fitzgerald, Lake Forest, secretary; L. O'Flaherty, Elgin, treasurer; E. C. Barrett, Joliet, and William Hanrahan, Chicago, were made a board of trustees, with power to elect a board of directors.

Master Steam and Hot Water Fitters' Association of San Francisco, Cal., has elected J. G. Sorgen as its president, to succeed F. W. Howard, resigned. The association will send a delegate to the convention of the National Association at Chicago, June 5-8.

Chicago Steam Heating and Ventilating Engineers held its second annual meeting Feb. 7 at King's Banquet Hall in Chicago. The attendance numbered 74 out of a total membership of 91. The following officers were elected: President, W. B. Graves; vice-president, John O'Shea; treasurer, William Sullivan; secretary, George H. Kirk; directors: Robert Gordon, Charles Glennon and G. F. Schample. E. E. Melum was re-elected recording secretary. Following the

meeting a dinner was served at which the speakers included Robert Gordon, Past President Charles Glennon, George H. Kirk and J. J. Cahill.

Eastern Supply Association held its regular meeting at the Hotel Astor, New York, Feb. 8. In the absence of President P. M. Beecher, the chair was occupied by Vive-President John A. Murray. One hundred members were present. Nine new members were elected, including Bradlee & Chatman Co., Boston; Mayor, Lane & Co., New York, and the United States Radiator Corporation, Dunkirk, N. Y.

Manufacturers' Notes

American Radiator Co., Chicago, will build a warehouse of mill construction at Denver, Colo.

Jenkins Bros., New York, will move into new and larger quarters at 82 White street about the middle of April.

American Blower Co., Detroit, Mich., announces the retirement of C. W. Old as manager of its Atlantic district with headquarters in New York. He is succeeded by Arthur Ritter. Mr. Old will engage in the manufacture of brick. He remains a director of the American Blower Co.

Crane Co., Chicago, has increased its capital stock from $13,000,000 to 17,000,000.

Standard Pump & Engine Co., Cleveland, O., has increased its capital stock, having recently purchased the business of the Schletter-Ripple Co., dealers in water supplies. The general sales department is under the management of C. A. Schletter.

American Radiator Company, Chicago, in its annual report, shows net profits of $1,197,517, which are the largest in the company's history. The figures for 1910 were $971,599. Although the common stock was increased from $5,000,000 to $6,150,000 the earnings for the year amounted to 16.05% as compared with 15.23% on the smaller capitalization last year. The sales for the year which resulted in this splendid showing were also the largest the company has reported. A profit-sharing system has been adopted by the company by which its employees may obtain stock on easy payments.

United States Radiator Corporation, Dunkirk, N. Y., announces the appointment of H. M. Anderson as assistant manager of its Omaha branch. This branch is under the direct management of Fred R. Bishop. The corporation's branch in Baltimore, Md., is now located at 700 North Howard street, where a new show room has been opened with Joshua Naylor in charge. The Philadelphia office has been moved from the Drexel Building to 122 North 13th street, where an elaborate display of the company's line of boilers and radiators is to be seen in charge of George W. Barr, the new manager of the Philadelphia branch.

Kennedy Valve Mfg. Co., Elmira, N. Y., has appointed F. K. Russell as its special representative in Philadelphia and vicinity. Mr. Russell has been connected with Crane Co. for the past seventeen years in its Philadelphia office.

New Incorporations

Martels Water Heater Co., St. Louis, Mo. Capital, $10,000. Incorporators: Chas. von Martels, H. W. Martels and J. F. Diamond.

Kollker Electric Co., Evansville, Ind. Capital, 10,000. To buy and sell heating, plumbing and electrical supplies. Incorporators: Henry Kollker, Jr., Amelia Kollker and C. Kollker.

Potts-Rine Supply Co., Columbus, O. Capital, $25,000. To take over heating and plumbing supply business of B. D. Potts. Incorporators: B. D. Potts, Frank Short, L. G. Williams, Harry L. Potts, and Frank M. Rine, formerly pur-

chasing agent for the Westwater Supply Co., of Columbus.

Columbus Supply Co., Columbus, O. Capital, $30,000. To deal in steam, gas and plumbing supplies. Incorporators: Frederick M. Abbott, Joseph Falkenbach, William L. Stehle, Harry H. Young and George Link.

Morrin Climax Boiler Co., Jersey City, N. J. Capital, $100,000. To manufacture boilers, steam generators, fittings, etc. Incorporators: T. F. Morrin, E. T. Morrin and Mr. O'Day. The company has purchased the plant of the West Pulverizing Machine Co., at Mallory and Pollock avenues, Jersey City.

Geo. A. Weld Co., 79 Milk street, Boston. Capital, $10,000. To deal in steam and hot water specialties. Incorporators: R. Linscott, president; George A. Weld, treasurer, and D. C. Linscott.

Atwood Vacuum Cleaner Co., Rockford, Ill. Capital, $50,000. To make stationary vacuum cleaners.

American Rotary Valve Co., Chicago. Capital, $500,000. To manufacture vacuum cleaners and a rotary valve. The company's headquarters will be located at 56 Dearborn street. President, William Waller; vice-president, D. Smith; secretary, Austin H. Hart; treasurer, Warren C. Fairbanks; assistant treasurer, William Waller, Jr.

Knapp Boiler Co., Minneapolis, Minn. Capital, $350,000. To take over the business of the Knapp Boiler Works. The company makes a sectional water-tube boiler for heating work.

American Heating & Supply Co., Rockford, Ill. Capital, $40,000. To engage in the manufacture of heating plants. Incorporators: Fred K. Houston, Merritt H. Mott, Harry S. Vandenberg and Charles Franz.

W. S. Hannum Plumbing & Heating Co., Danville, Ill. Capital, $20,000. To take over heating and plumbing business of W. S. Hannum & Co. Incorporators: Walter S. Hannum, Albert Hannum and William Halbert.

Metropolis Heater & Appliance Co., New York. Capital, $25,000. Incorporators: T. La Var, H. A. Archibald and R. W. Booker, all of New Rochelle, N. Y.

America Heating & Supply Co., Rockford, Ill., capital $40,000, fully paid up, is the title of a new corporation formed to take over the business of the America Heating Co. and also to conduct a general jobbing business in heating and engineers' supplies. The company will greatly enlarge the operations of the former firm in the contracting and installation of heating and ventilating systems. Incorporators: F. K. Houston, M. H. Mott, Charles Frans and H. S. Van Denberg, all of whom have been active in the former company under Mr. Houston. The officers of the new company are: President, F. K. Houston; vice-president, M. H. Mott; secretary and treasurer, H. S. Van Denberg; general superintendent, Charles Frans.

American Heating and Ventilating Co., Cleveland, O.; capital $10,000. Incorporators: Chas. L. Sobotta, T. M. Golden, Lena G. Moulder, Albert W. Moulder and Carrie C. Sobotta.

Plant Equipment Co., Cleveland, O.;

capital $10,000, to make and install heating and power plants. Incorporators: Charles Eisele, A. D. Dickson, S. E. Manix, E. W. Kraft and J. F. Patterson.

Winterbottom Construction Co., Cleveland, O., capital $10,000, to conduct heating and ventilating business and to do construction work. Incorporators: Joseph and Minnie Winterbottom, Edwin S. Dickerson, John H. Haas and Chas. B. Benz.

Wilkinson Foundry & Mfg. Co., Bridgeport, Pa., capital $200,000, to take over the business of the Wilkinson Foundry Co. and Lorenna Foundry Co., of Bridgeport, Pa., and the Stroud-Wilfong Co., of Philadelphia. The company will make feed water purifiers and other heating specialties. President, Benjamin F. Evans; vice-president, C. S. Wilfong; secretary and treasurer, Joseph C. Lorenna.

Warneke-Deringer Co., Minneapolis, Minn., organized to conduct a jobbing business in heating and plumbing supplies. The members of the firm are Hermann, J. Warneke and George H. Deringer.

Flectropic Products Co., Buffalo, N. Y., organized to manufacture radiators. The company will build a fire-proof factory at Elmwood and Harris avenues.

Ideal Pump Co., Denver, Colo., capital $25,000. Incorporators: J. T. Moynahan, T. J. Moynahan and Wm. Wahl.

Scott & Co., Philadelphia, capital $100,000, to conduct a heating contracting business. Incorporators: David E. Rattan and Oliver E. Solomon, of Philadelphia, and James Lord, of Dover, Del.

Untereiner Heating Co., Jersey City, N. J., capital $15,000, to deal in heating and plumbing supplies.

Hankinson Plumbing & Heating Co., Hankinson, N. D., to conduct heating and plumbing contracting business, taking over the business of John Green. The manager of the new firm is C. C. Putnam.

José Heating Co., Portland, Me., capital $10,000, to maintain a steam heating and power plant in that city. President, John C. Small; treasurer, Richard Webbs.

Knox Terpezone Co., Elizabeth, N. J., capital $250,000, to manufacture heating and ventilating appliances with special reference to hospital. Incorporators: William J. Knox, Lewis H. Rogers and W. A. Sherman.

Spencer & Haviland, 174-176 South Portland avenue, Brooklyn, N. Y., have failed with liabilities amounting to $43,400. The firm is one of the oldest supply houses in the East, having been establishe for nearly forty years.

Business Changes

Limbert-Smith Plumbing Co., Akron, O., has increased its capital stock from $10,000 to $25,000. The officers of this enterprising concern are: President, J. D. Slater; secretary, B. G. Smith.

Ideal Heating Co., Columbus, O., has increased its capital stock from $10,000 to $25,000. The company manufactures gas furnaces and fittings. President, Samuel Fippin; secretary, F. C. Medick; general manager, R. S. Thompson; mechanician, O. L. Skinner; business manager, R. A. Magley.

Wanted

Wanted, foreman of sheet metal shop for large heating and ventilating firm on Pacific Coast. Must thoroughly understand the business and have good executive ability. $1,700 salary to first-class, capable man. Give name, age, references, and experience. Address, Ventilating, care HEATING AND VENTILATING MAGAZINE.

Heating and Ventilating Engineer, with eleven years' experience, desires to represent live lines connected with the heating and ventilating field in Chicago and surrounding territory on a commission basis. Thoroughly versed in hot-blast engineering. Desires line of asbestos or magnesia products. Ample warehouse facilities for stock. Address, Chicago, care of HEATING AND VENTILATING MAGAZINE.

THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK APRIL, 1911

Air in the New York Subway

BY DR. GEORGE A. SOPER

EDITOR'S NOTE.—*The accompanying paper is a résumé of an elaborate series of experiments conducted by Dr. Soper for the Board of Rapid Transit Railroad Commissioners in New York. The detailed report of these tests, together with many other researches on the general subject of air conditions in subways, both in this country and Europe, is contained in Dr. Soper's book, "Air and Ventilation in Subways," recently issued.*

When the New York subway was first opened there was a good deal of complaint as to the condition of the air. The subway grew hot and there were unpleasant odors. Some more or less scientific people made a few quick-and-easy determinations of the oxygen and the carbon dioxide in the air, and published alarming reports in the newspapers. Professor Chandler, of Columbia University, made some careful examinations of the carbon dioxide, which were reassuring enough for him and many others, but the Rapid Transit Commissioners were not fully satisfied. They held the view that here was a great experiment. The subway was certainly uncomfortable. Something was the matter with the ventilation. Was the air dangerous to breathe? If the air was bad and could not be made wholesome, there would be no more subways built. The importance of this question was considered great enough to warrant thorough investigation. I was asked to make the investigation and did so.

The temperature and humidity were determined. There were 50,000 determinations of the temperature and humidity. The oxygen was estimated; there were 80 determinations of oxygen. The carbon dioxide was determined; there were 3,000 analyses of that. The numbers of bacteria were determined; there were about 2,500 bacteriological examinations. The dust was analyzed. I found the problem to be largely one of dust, so far as health was directly and seriously concerned.

I found at the outset that the ordinary quick-and-easy methods of analysis employed in most ventilation work were not suitable for this case. And so the most accurate determinations which it was practicable to make on a large scale and under the difficult conditions of subway traffic were employed.

It was only by the most refined methods that we could detect any difference between the oxygen in the subway and that in the outside air. The difference averaged only about 1½ parts of carbon dioxide per 10,000 parts of air. It was almost incredible that such a slight difference should exist while the air in the subway was so unpleasant, yet the fact could not be disputed.

It was difficult to get samples. It was desirable that they should be

collected, as far as possible, away from people. So I had the sample bottles put in a basket with a pump and a thermometer. The investigator appeared to be a young man proceeding to market. He would go to the part of the subway previously determined on, await his opportunity and then take the cover off the basket sufficiently to insert a rubber tube. Then with the air pump he would pump air through a flask until the flask was filled with the air to be analyzed. I found we could get a reliable sample in that way, and in that way alone.

Fig. 1 shows some of the results. There were about 2,000 analyses averaged to get the figures from which these curves were made. The amount of carbon dioxide in the air of the subway is shown by the heavier upper line; that in the streets by the lighter line below. Note the correspondence between the rising and the falling of these two lines.

VARIATION OF CO_2 IN STREET AIR

The observations extended over several months. I found there was a difference in the amount of carbon dioxide in the air of the streets at different hours of the day. Rush hours in the subway always gave larger amounts of carbon dioxide than other hours. And, curiously enough, the rush hours in the subway appeared to be the rush hours in the streets. Apparently, the air in the streets was affected by the great number of people in them. The striking rise shown in December is due to the large increase in the number of people using the subway and streets. It was the Christmas season.

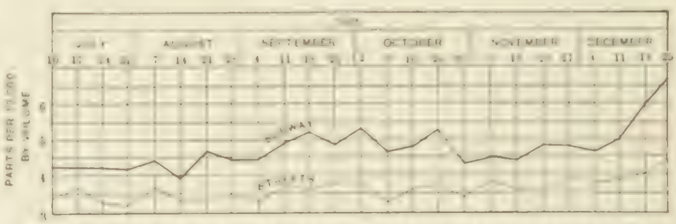


FIG. [illegible]—AVERAGE OF [illegible] ANALYSES OF SUBWAY AND STREET AIR

There were regular variations in the chemical condition of the air at different hours of the day and night. At 6 a. m. the carbon dioxide in the subway was at a minimum. It then increased rapidly up to the end of the morning rush hour. From the end of the morning rush hours there was a gradual reduction until just before noon, when the reduction ceased and there was a slight increase. The increase was apparently due to the fact that there was a slight rush of people who used the subway about noon in the shopping district. After noon there was a progressive reduction down to the beginning of the rush hours of the afternoon, when there was a decided increase. From that time there was a pretty constant reduction until morning.

There was much more carbon dioxide at 6 p. m. than during the rush hours of the morning, because more people traveled at that time. The crowding was much greater because the rush period was shorter. Most of the people who went to business between seven and nine wanted to get home as soon after six as possible.

Fig. 2 shows a compound diagram which may need a word of explanation. We have here the amount of carbon dioxide found at the different stations. The subway is 20 miles long, and the most interesting part of it, from the standpoint of ventilation, is between Brooklyn Bridge and Seventy-ninth Street. This diagram represents the condition between those two points. The amount of carbon dioxide in the air at different stations for the period from July 14 to September 1 lies along the lower broken line. Later in the season, when more people were traveling, there was much more carbon dioxide at those stations. We have this fact shown on another broken line. Later, in November, when the heat began to

abate and more active business conditions led more people to take the subway, there was a further increase in the amount of carbon dioxide, and so on until the end of December. There is one diagram for the afternoon hours and one for the morning

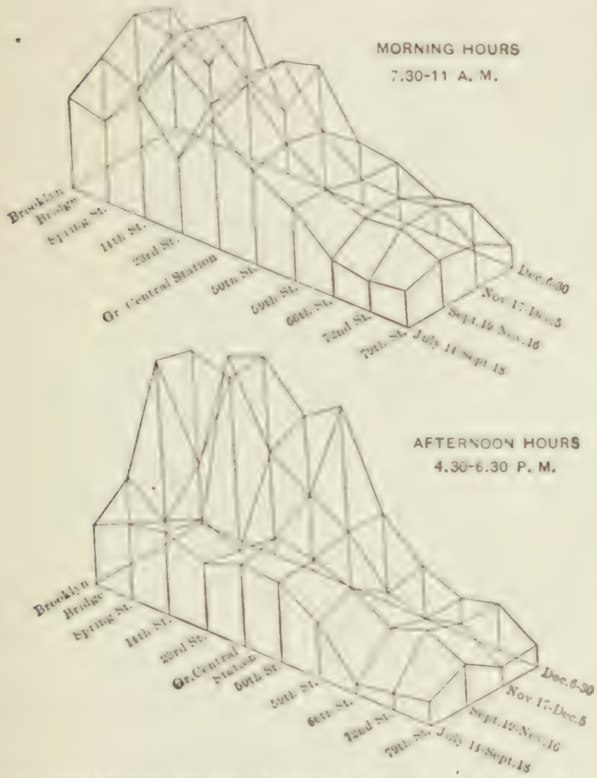


FIG. 2 VARIATIONS OF CARBON DIOXIDE IN NEW YORK SUBWAY, AS SHOWN BY FOUR TESTS

hours. For each station you will find on this diagram the amount of carbon dioxide for the months covered in the investigation.

VENTILATION OF SUBWAY DEPENDS ON NUMBER OF OPENINGS

One of the most useful results of the whole work is illustrated in Fig. 3. The point illustrated is that a distinct relation existed between the number of openings to the street and the condition of the air. This led me to the opinion, which I have since been able thoroughly to confirm, that the New York subway and other subways of its kind will ventilate themselves if they are given a chance. The New York subway did not have a chance, and the Paris subway did not, for the reason that it was too tightly enclosed for the air to move in and out with the requisite freedom.

It is not necessary to put fans into subways like the New York subway. In fact, it is doubtful if fans, even on the largest scale practicable, will produce material improvement, except immediately at the points where, for example, outside air is pumped in. Fans will not improve the air sensibly for any considerable distance. This was proved by my investigations. But if you will give the subway openings enough, it will breathe of itself. The breathing bears a rather close analogy to that of animals.

The subway in New York has been materially improved by providing blow-holes through which the air set in motion by the trains can move in and out. I have said the need of so much opening was not evident at first.

METHOD OF MAKING BACTERIOLOGICAL EXAMINATIONS

Bacteriological examinations of the air were made. Professor Sedgwick devised filters for air some years ago, and it was partly upon his plan that our filters were devised. They are small tubes filled with sand and plugged with cotton at both ends. We fastened two filters in tandem on a rubber tube, which was connected with a well made and carefully operated pump. The number of strokes of the pump gave us the quantity of air passed through the filters. In passing through the filters the air parted with its germs. After filtration the filters were taken to the laboratory and there dealt with in a way commonly employed in bacterial analysis.

As was said, the fans did not materially improve the general air in the subway; the blow-holes did. Before the fans were put in it is probable that the air was renewed once every half hour. The amount of renewal after large sections of the roof were opened was very great. It wasn't possible to tell exactly how often the air was renewed, for the reason that the number of people traveling in the subway was not known by the city. There was no census of travel for a long time after the subway was put in operation and none until after my investigations had been completed.

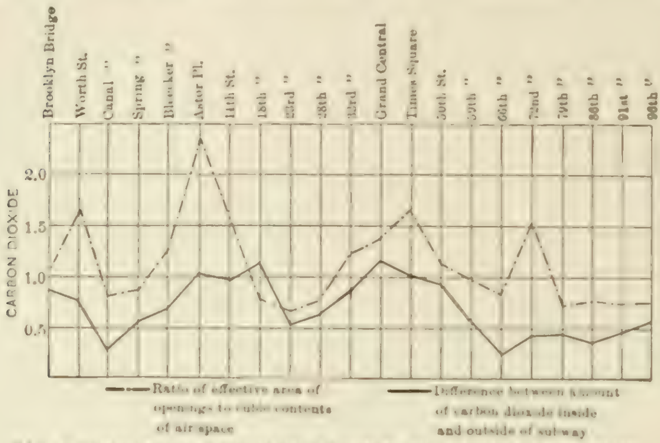


FIG. 3—RELATION BETWEEN NUMBER OF OPENINGS TO THE STREET AND THE CONDITION OF THE AIR

In Fig. 4 you see the results of determinations of the number of bacteria at the different stations throughout the length of the subway and in the streets overhead. There is a general correspondence between these two sets of figures. The average of all the analyses shows that about half as many bacteria were found in the air of the subway as in the air of the streets. The numbers of bacteria varied with a good many circumstances, one of them being the amount of air moving in the subway.

The accompanying table shows the effect of improper methods of cleaning. The porters swept the platforms without first moistening them, and this greatly increased the numbers of bacteria in the air. The movement of the trains kept the bacteria in the air because the movement of trains set the air in motion, and the dust particles were kept afloat also by the air currents.

DIFFICULTY OF DETERMINING DUST IN AIR

It was very difficult to devise a plan for determining the quantity of dust in the air. The difficulty lay in the necessity of examining a large volume of air. The amount of dust was small to separate and weigh with accuracy, so that a special apparatus was employed. It consisted partly of an ordinary Root blower, adjusted so that it drew air through a gas-meter. The meter was carefully tested and found to work with sufficient accuracy in this manner. A filter was attached to the gas meter, so that when this pump was operated, the air passed down through the filter to the meter. The filter was composed of sugar. After a sufficient number of cubic feet of air had been passed through the filter, the filter was disconnected and taken to the laboratory. There the sugar was dissolved in water. The water was then filtered and the solid particles were dried and weighed.

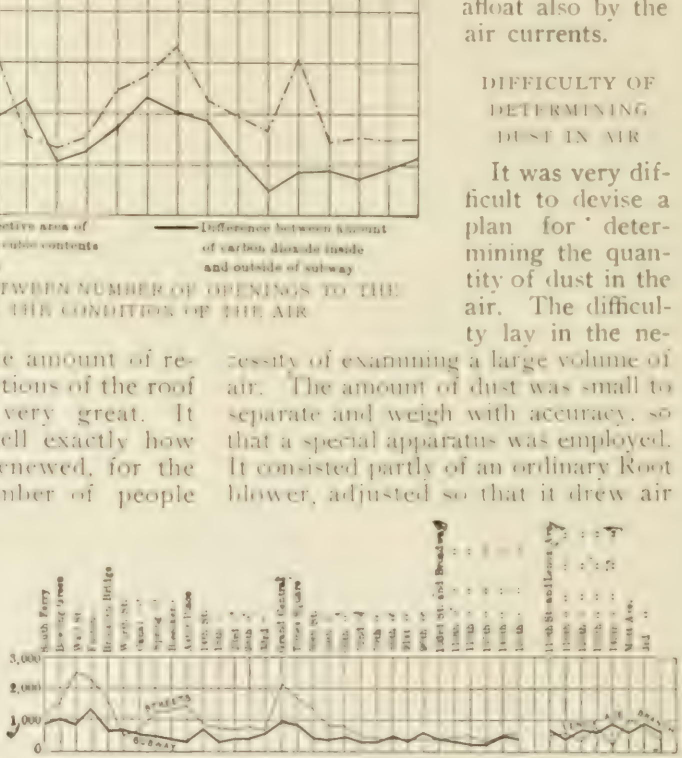
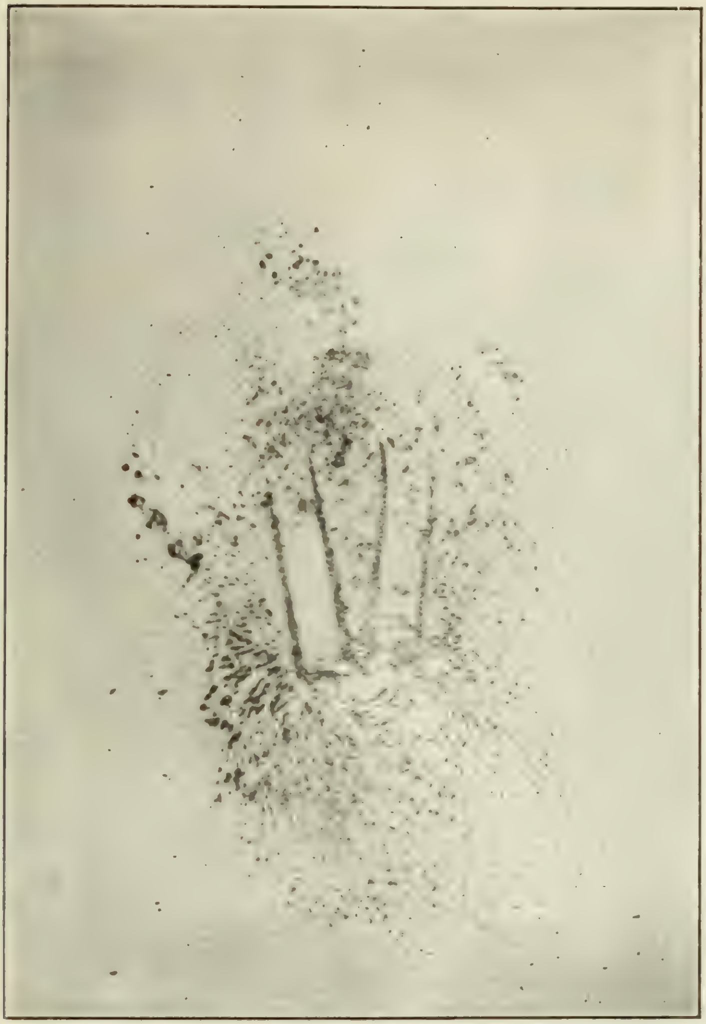


FIG. 4—NUMBER OF BACTERIA AT DIFFERENT POINTS OF SUBWAY AND IN STREETS OVERHEAD



MAGNETIC FIELD FORMED BY SUBWAY DUST
A Piece of Paper was laid on top of a Horse Shoe Magnet and Subway Dust was Sprinkled on the Paper

EFFECT ON THE NUMBERS OF BACTERIA IN THE AIR OF THE SUBWAY PRODUCED BY SWEEPING THE PLATFORMS IMPROPERLY

Place	Time, A.M.	Microorganisms per Cubic Meter of Air		Ratio of Bacteria to Molds
		Bacteria	Molds	
Fulton Street Station, South End, west platform. Remote from openings to streets	10.25	4,900	100	49 : 1
Porter began sweeping near by	10.41	13,200	50	264 : 1
Still sweeping, but farther off	10.57	8,100	0	....
Still sweeping, middle of platform	11.12	8,500	0	....
Average	....	8,600	38	226 : 1

Heating and Ventilation of Union League Club, Philadelphia

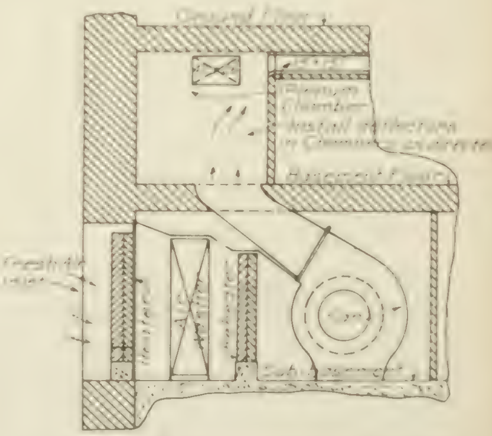
The Union League Club in Philadelphia has recently found it advisable to provide larger quarters for its members and to this end has built a six-story addition to the original club house. In design and appointments the new building follows most modern practice and particular attention has been paid to insuring absolute comfort for the occupants.

The question of heating and ventilation received an unusual amount of attention. Two separate systems of indirect heating are employed, as well as a vacuum steam system for use with direct radiators. For extracting the vitiated air from the building three distinct exhaust systems have been designed. The main air supply is obtained from a vertical duct, leading from a sidewalk grating down to the sub-basement, where a right angle turn brings the fresh air to a tempering coil and air washer of the Webster type. The former contains 1,650 sq. ft. of heating surface and beyond the air washer is a reheater of the same capacity. The air washer is designed to cleanse 45,000 cu. ft. of air per minute. The spray water is circulated by means of a 2½ in. Worthington centrifugal pump direct driven by a 7½ H. P. motor.

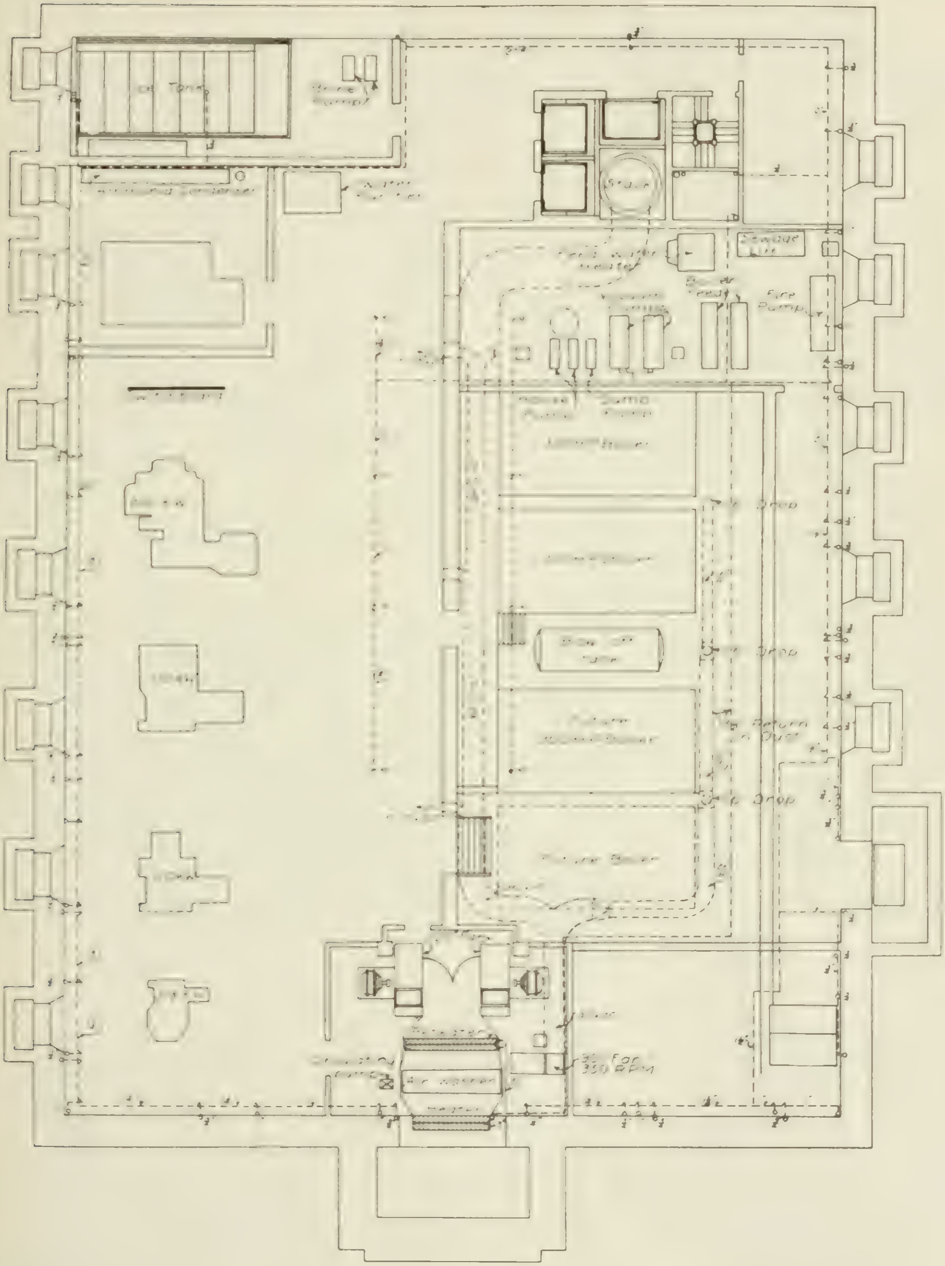
Beyond the reheater the air duct divides into two branches, each branch leading to a motor driven fan which discharges the air upward through a short vertical shaft to three main horizontal ducts under the ground floor ceiling. Of these the largest, which is 15 ft. by 15 in. in cross section, runs under the ground floor corridor, with branches leading off from either side to supply warm air to this story of the building. At the rear end of the corridor the duct divides into two branches leading to the sides of the building where risers lead off to supply the first and second floors. Indirect heating units are installed in these branches under the ground floor as secondary heaters for the first and second floors. At the front end of the building two similar branch ducts lead from the vertical warm air shaft and supply the remaining area of the first and second floors by flat vertical air ducts in the same manner.

For the ventilation of the engine and boiler rooms a separate fan is provided. This fan, which is located in the sub-basement beside the air washer, supplies untempered air for the operating force through two main horizontal ducts on the sub-basement ceiling.

The air supply for the third and fourth floors is furnished by a blower in the loft which discharges fresh air through an indirect heater to ducts supplying both floors. The source of supply being at a considerable height above the ground it was not considered necessary to install an air washer for this system, its place being taken by a cloth filter over the inlet pipe.



SECTION OF MAIN AIR SUPPLY SYSTEM



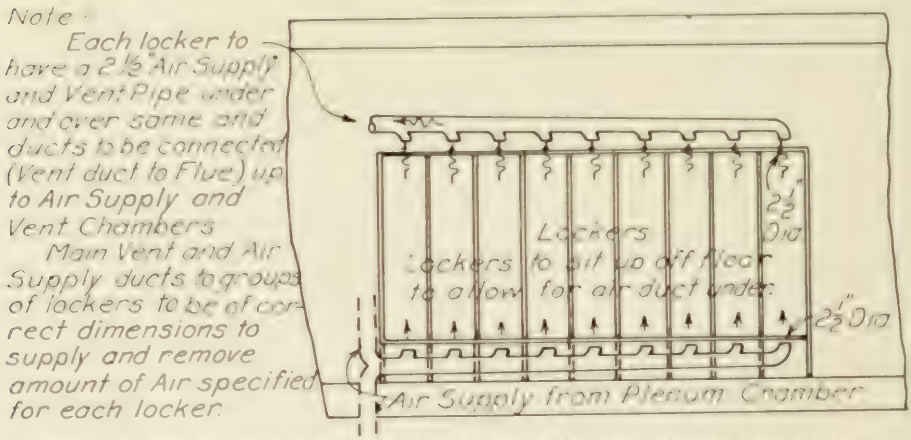
PLAN OF SUB-BASEMENT, UNION LEAGUE CLUB, PHILADELPHIA, SHOWING MAIN AIR SUPPLY SYSTEM, ALSO SYSTEM FOR VENTILATING ENGINE AND BOILER ROOMS

There are three separate exhaust systems, one for the ground floor, a second for the first and second floors, and another for the third and fourth floors. No positive ventilation is provided on the top floor, which is used for sleeping rooms.

The ground floor system is particularly complete. On this floor are located the bowling alleys, barber shop, lockers, etc. Individual inlet and discharge ducts are provided for each separate locker, thus insuring rapid drying of clothes and the entire absence of the odors so often associated with locker rooms. All the exhaust ducts on this floor are vented through a main duct running along the corridor ceiling and discharging to the roof through a to that supplying the ground floor and surmounted at the roof with a 72-in. disc fan.

The exhaust system for the third and fourth floors is practically identical with that for the two floors below except that the main horizontal exhaust ducts are run in the loft and discharge into the space above the main stair skylight where is located a 36-in. disc fan.

So numerous are the inlet and outlet openings for the various fan systems that plenty of air can be circulated without the necessity of high velocities and hence with a minimum of danger from drafts. As the fans and the air washer pump are all motor driven, starting and stopping them is an exceedingly

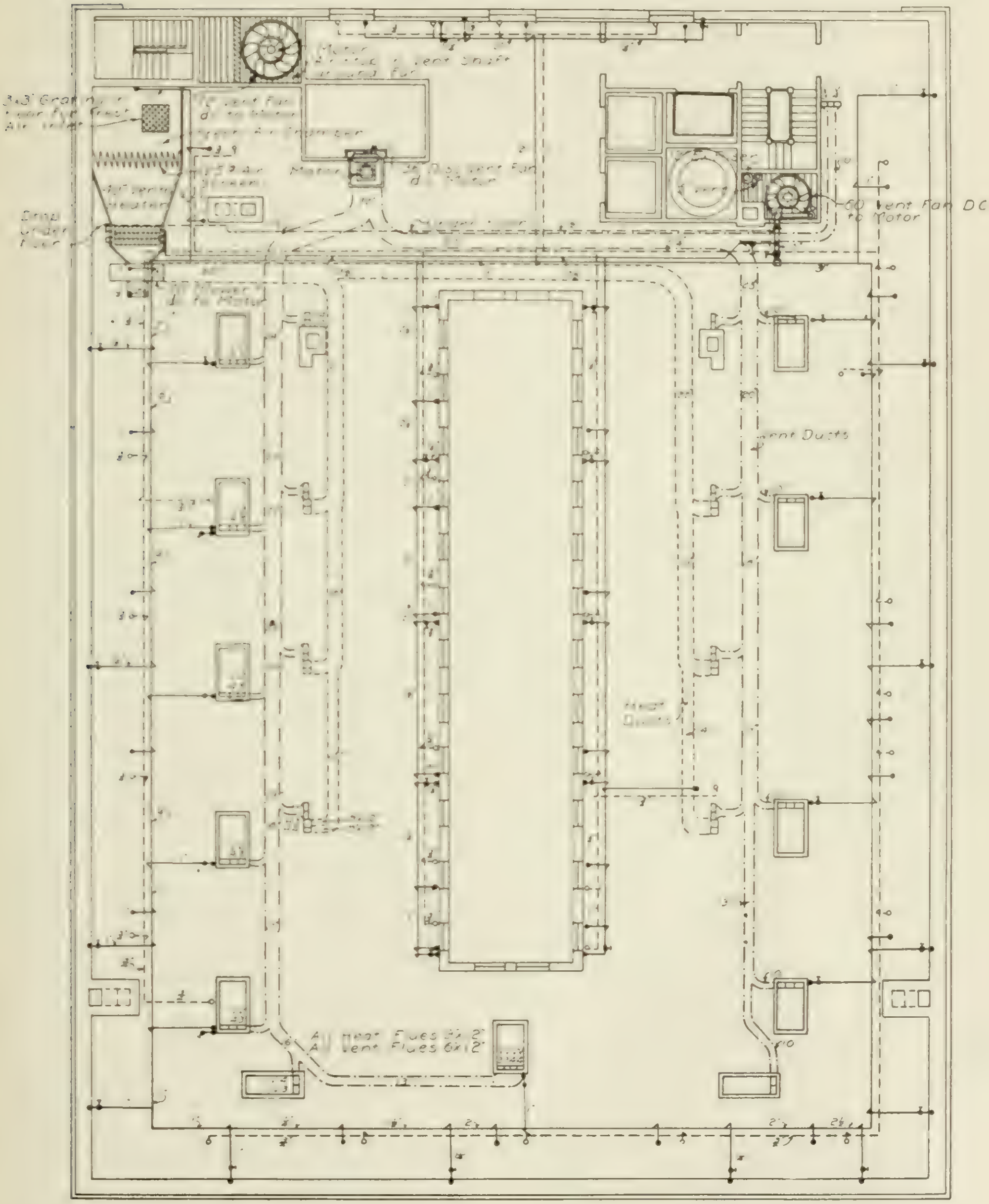


DETAIL OF AIR SUPPLY AND VENT DUCTS FOR LOCKERS, UNION LEAGUE CLUB, PHILADELPHIA

vertical air shaft. To insure positive movement of the air a 60-in. disc fan is located on the roof.

The system of exhaust ventilation for the first and second floors is similar in its general features to that for the ground floor except that it is not quite so complete as these two floors are for general club room and do not require as much care in ventilating as does the ground floor. The first floor is ventilated by means of vertical ducts which discharge into parallel horizontal ducts on the ceiling of the second floor. The latter also serve the second floor and convey the air to a vertical shaft similar simple matter and no other attendance except occasional oiling is required. The temperature regulation of this building is entirely under thermostatic control, both the indirect heating systems already described and the direct units being automatically regulated at all times.

All direct radiators are operated on the Webster vacuum system. The main 12-in. exhaust line from the engines, supplemented by a 10-in. line from the pumps, runs to the feed water heater where an 8-in. branch pipe is taken off to the heating system. This connects with an 8-in. main supply riser running to the



LOFT PLAN, UNION LEAGUE CLUB, PHILADELPHIA, SHOWING AIR SUPPLY SYSTEM FOR THIRD AND FOURTH FLOORS AND EXHAUST SYSTEMS

loft. A branch header connects with this riser just below the ground floor level to supply the direct units in the basement, the ground floor and the first and second floor, the three latter stories being served by up-feed risers and the basement by down-feed risers. Down-feed supply lines are dripped to the returns through water seal motors.

A ring header in the loft serves the direct radiators on the third, fourth and fifth floors, the latter by up-feed risers and the third and fourth floors by means of down-feed supply pipes. The returns from the fifth floor are piped to a ring header in the loft and thence by way of a vertical riser to the basement return main, while the lower floor returns flow through separate risers to the main return header in the sub-basement. This main terminates at the two 8 in. x 12 in. x 12 in. vacuum pumps, to either or both of which it may be connected. The discharge from these pipes passes to an air separating tank on the sub-basement ceiling and thence to the feed water heater. Separate supply and return lines serve the indirect heaters, the returns connecting with the main return header.

Steam for all purposes is supplied by three 300 H. P. Edgemoor water tube boilers through two main steam headers. One of these supplies the generator engines, with a branch to the refrigerating plant, and the other furnishes steam for all the other pumps. By means of cross connections it is possible to supply live steam through reducing valves, if necessary, to the heating system.

The operation of the heating and ventilating system of this building has justified the elaborate layout. Flexibility is one of its most noticeable points and the detailed thoroughness of the architect's plan as carried out by the engineers, Francis Brothers & Jellett, Inc., has resulted in a most satisfactory sytem.

Horace Trumbauer is the architect of the building. The contractors for the work were Charles Monday & Co.

A Novel Drying System

A novel drying system, which operates successfully, was recently designed by F. W. Dean, mill engineer and architect, of Boston, for the drying of fibre board. The fundamental purpose was to give such flexibility to the system that different chambers, different temperatures of air and different degrees of humidity might be utilized.

The complete system is divided into six individual groups of apparatus, two of which may be classed as single groups and four as double groups. Each group comprises a series of steam coils, supported by angle iron frames suspended from the roof beams of the drying room. The double groups comprise 2,520 lin. ft. of 1¼ in. pipe; one of the single groups contains 1,296 ft. and the other 1,440 ft. of the same size pipe. The pipes are made into return bends 6 in. on centres. Each individual group consists of 5 unit coils. Each cell in turn contains 12 pipes, 8 ft. long in the case of the single groups, and 14 ft. long in the case of the double groups. There are three coils in each section and fifteen coils in each chamber.

The single groups are supplied with exhaust steam through 4 in. pipes and the double groups through 6 in. pipe. Valves are provided in all branches to the individual unit coils so that any one can be cut off to reduce the temperature or for repairs, if such should prove necessary. The drips are trapped and discharged into a main which leads to the receiver pump.

All of the groups are enclosed in 2 ft. x 6 ft. flues made up of angles and asbestos-covered metal, located near the ceiling of the room so that the space beneath is left entirely clear for the hanging of the fibre board, across which the air is forced. Motor driven fans supported in a monitor force the air through the coil chambers where it is heated to the desired degree. Each fan has a 54 in. wheel running at 300 R. P. M., chain driven by an individual 5 H. P. motor. There are two fans for each double unit and one fan for each single one.

The exhaust flues from the drying rooms have an arrangement of dampers whereby the same air or any proportion of it can be used over and over until saturated. By the proper regulation of the air supply, a great saving of heat can be effected.

Some of the Factors that Affect the Cost of Generating and Distributing Steam for Heating, a paper by Charles R. Bishop, read at the last annual convention of the National District Heating Engineers in Toledo, has been reprinted by the American District Steam Co., North Tonawanda, N. Y., as Bulletin No. 120. We understand that copies may be had for the asking by addressing the company.

How Wind Affects the Heating of Buildings

Concluded from March Issue

Extract from Report of Tests of Gymnasium Buildings at Michigan University by J. E. Emswiler, mechanical instructor, under supervision of M. E. Cooley, dean of the engineering school:

Men's gymnasium. Exposed on west, south and east. Usual number of windows and doors. Large and very leaky skylight. Three doors leading to basement. Heated and ventilated by fan system. Inlet ducts in north wall above running track (approximately second story); vent ducts in north wall at basement floor. Area fresh air openings, 32.31 sq. ft. Area vent openings, 33.45 sq. ft. Floor registers in main floor at east and west walls.

A series of tests were made in the spring of 1909 to determine leakages around doors and windows and the effect of leakage on vent flow. Most of the windows showed leakage at bottom or sides of sashes and between sashes. This was ascertained

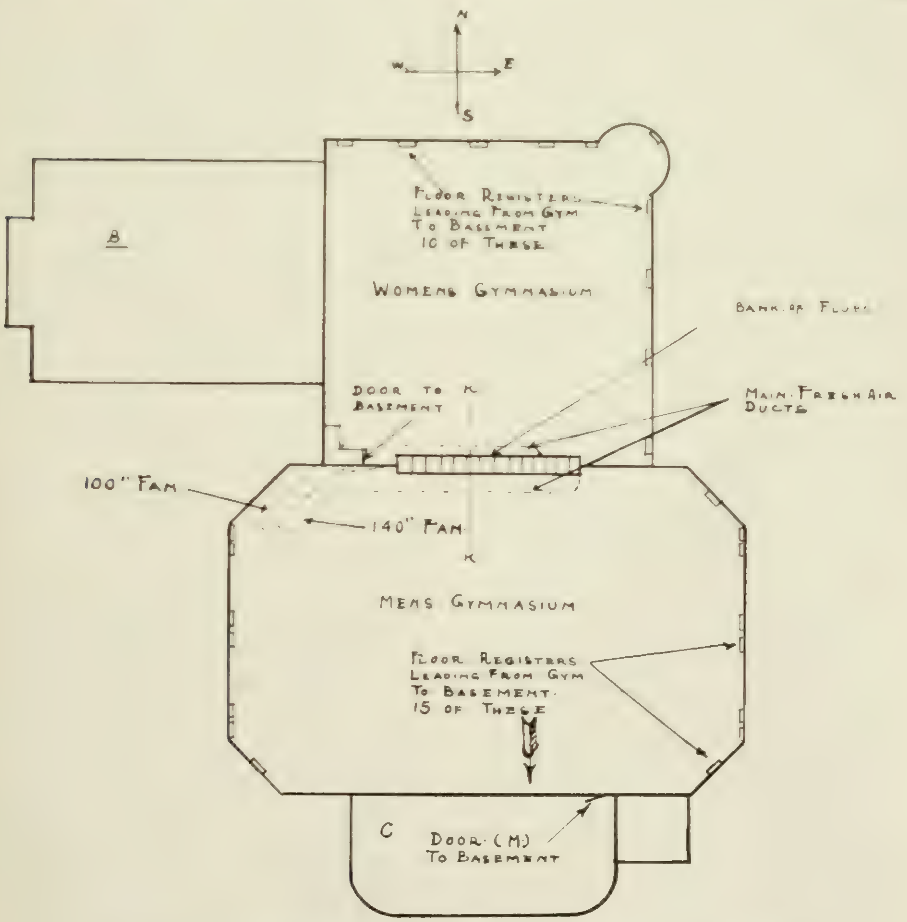


FIG. 1—ARRANGEMENT OF HEATING SYSTEM IN MEN'S GYMNASIUM, UNIVERSITY OF MICHIGAN

by means of a special funnel, having one end in the form of a long narrow opening, designed to fit over a crack at bottom or side of a door or window sash.

From this end the shape gradually

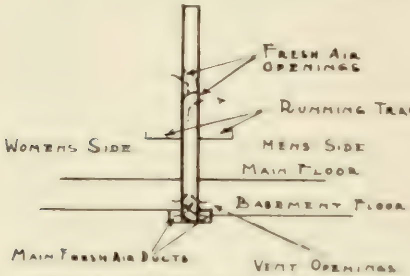


FIG. 7.—SECTION ON K K (FIG. 1)

changed, until, at the other end it became circular, and of the size of the wheel guard of an anemometer. When the funnel was placed over a crack with the anemometer in place, if there was an appreciable leak through the crack it was indicated by the movement of the anemometer wheel. While this did not provide a quantitative measurement of the leakage, it did afford an excellent means of comparing the leakage at different places.

The velocities read ran as high as 100 ft. per minute to 18-in. length of crack, and in an especially bad case as high as 350 ft. per minute. Leakage tests were again made in the spring of 1910 after the windows had been equipped with a metal weather strip. No leakage could be detected except in one case due to a bad sash. Leakage at cracks of doors showed a reading of about 300 ft. per minute.

In the tests of 1909 the fan supply was 25,350 cu. ft. per minute, and the average vent volume was 7,100 cu. ft. per minute, or 28% of the supply. All windows and doors were closed during tests.

In the summer of 1909 all windows were equipped with an expansion joint metal weather strip. In the spring of 1910 a series of tests similar to those of 1909 was made.

During these tests the fan supply was 22,000 cu. ft. per minute, and the average vent volume was 11,190 cu. ft. per minute, or 49.5% of the supply.

The foregoing shows primarily the effect of leakage as the wind conditions in 1909 did not differ greatly during the different tests. In one test in 1909, with stiff breeze from the southeast, the vent flow was 7% less than with a slight breeze from the northeast.

TEST OF WOMEN'S GYMNASIUM

Women's gymnasium. Exposed on north and east sides. Large and leaky skylight. One door leading to basement. Fan system. Inlet ducts in south wall, same height as in men's gymnasium. Floor registers in main floor north and east sides. Vent ducts in south wall of basement. Area fresh air openings, 20.46 sq. ft. Area vent ducts, 18.13 sq. ft. Fan supply, 1909, 10,750 cu. ft. per minute. Amount at vent with stiff southeast wind, 1,780 cu. ft. per minute. Amount of vent with slight northeast wind, 4,000 cu. ft. per minute. All windows weather stripped in 1909. Fan supply, 1910, 9,530 cu. ft. per minute. Amount at vent, 4,170 cu. ft. per minute. Negligible variation on account of wind noted after weather stripping.

The foregoing shows the effect of leakage and wind both to some extent.

In all the tests it is assumed that

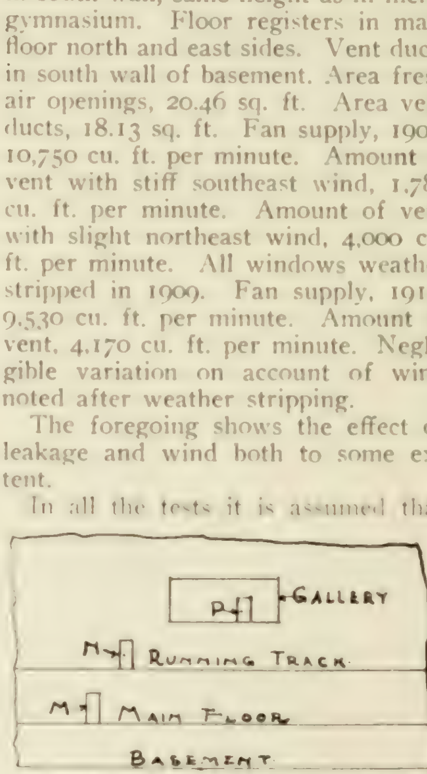


FIG. VIEW IN MEN'S GYMNASIUM LOOKING SOUTH (IN DIRECTION OF ARROW. FIG. 1) SHOWING DOORS ON SOUTH SIDE OF BUILDING

the leakage from doors and skylights was fairly constant, as no attempt standardize this leakage was made. It is the opinion of your committee that a study of the foregoing examples will demonstrate the fact that leakage and wind velocities cause a great range of effect on interior conditions of heat and ventilation much greater than commonly supposed.

We deplore the fact that the lack of time has prevented a greater accumulation of data, and trust that future committees may be enabled to gather more information along this line. If we can approach the standard used in Germany, much controversy between engineers and heating contractors on the one side and owners and architects on the other will be avoided. It is manifestly unfair for an architect to make plans and specifications for a building and require a heating contractor to heat the "plans" to 70° F., or anything else, in zero or other weather. The variation in amount of free opening about doors and windows is very great.

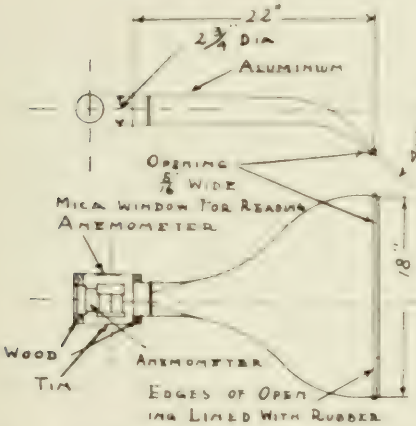


FIG. 4.—SPECIAL NOZZLE FOR MEASURING LEAKAGE

It will be recalled that C. B. Thompson, after spending some time in research work in Germany, said at the semi-annual meeting of this society at Niagara Falls in July, 1908: "What is known as the German co-efficient of heat losses is used and accepted as a standard all over the continent of Europe. The German co-efficient for glass had nothing whatever to do with the way the sash is fitted to the frame, and, when you come to think of it, it would be impossible to give a co-efficient for the glass and the leakage about the sash, because one might be tightly fitted and another ¼ in. away from the frame as you describe. If this society can get together sufficient data to establish a set of standards for the guidance of heating engineers, architects and owners, it will have accomplished a great work. With an accepted set of standards a heating engineer who installed work in accordance with such standards would collect his pay and not wait, as he now has to, until cold weather to test the apparatus before he can get a final settlement. In Germany all that is asked of a heating engineer is to install the heating apparatus in accordance with Rietschel's formulæ. Then, if the heating apparatus does not heat, the builder is called upto to make good."

Capt. Andrus B. Reck, of Copenhagen, told one of our members recently that the plan of procedure in Germany was substantially as follows:

The government has a set of standards for different classes of construction. Building plans are submitted to an engineer or contractor, who lays out his heating plant in accordance with these standards. The layout is inspected, and, if correct, is O.K.'d by a government inspector. After the plant is installed it s tested by a government inspector and, if properly installed, the contractor's bill is O.K.'d by the inspector. The contractor does not have to wait a heating season for his money. If the building does not heat satisfactorily in cold weather, the inspector is again called in, and his verdict is almost invariably "Fix up your windows."

Your committee is confident that members of this society, particularly those interested in central heating plants, have large quantities of data bearing directly on this subject. Such data would enable a committee to tabulate and report information which could be used in formulating a standard.

The committee which reported the investigations was composed of D. M. Quay, chairman; H. W. Whitten and George Huey.

Air Supply in Submarine Work

As a further contribution to the discussion of the effects of vitiated air on the human system, some interesting facts have been obtained by government experimenters from manufacturers of diving apparatus and submarine appliances and from the users of such apparatus.

It is a common custom for divers to measure the amount of air furnished them by the pressure of certain gauges connected with the pumps. The release valve in the diving helmet is adjusted by the diver himself so as to allow the air to escape as fast as desired. The man at the surface working the pump is supposed to keep the pressure constant. While much of the information regarding the ventilation of diving helmets is based on empirical rather than strict scientific grounds, certain estimations can be made which are probably approximately correct.

The manufacturer of one diving apparatus stated that for a diver working at 50 ft. under water, sufficient air would be furnished by a 3-cylinder, single-action pump with cylinder of 3.5 in. diameter and a stroke of 6 in. working at about twenty strokes per minute. The volume of air thus delivered, assuming the diver to be at atmospheric pressure, is computed to be 57.1 liters. (Approx. 2 cu. ft.)

Another manufacturer states that a single-cylinder, double-acting pump with a 4-in. cylinder and a 6-in. stroke will supply most men at 50 ft. of water. Some men have used it for 60 ft., while others say it is not enough for 40 ft., the same speed being used in all cases. This difference in the amount of air required by different individuals is quite commonly noted by divers. A fair estimation of the average efficiency is said by the second manufacturer to be the amount of air discharged by a 3-cylinder, single-action pump, with pistons 3.25 in. in diameter and a 6-in. stroke. This pump, when supplying a diver at almost any depth, is operated at about thirty turns per minute, thus giving 73.6 liters per minute. (Approx. 2½ cu. ft.) It is stated that the English divers use for excessively deep work, say 150 ft., a 3-cylinder, single-action pump, each cylinder 4 in. inside diameter and 6-in. stroke, with about the same number of turns per minute, i. e., 30, which would give a current of 111 liters per minute (nearly 4 cu. ft.) Although there are wide variations in the volume of air delivered by these different forms of pump, it is probably fair to assume that divers in general obtain about 65 to 70 liters per minute, or somewhat less than the rate of ventilation in the respiration calorimeter referred to in recent issues of THE HEATING AND VENTILATING MAGAZINE. It is stated that divers working in 10 to 20 ft. of water could probably work under these conditions for twenty-four hours without coming up, although their sojourn is customarily not longer than five or six hours. The return to the surface, however, when working in shallow water is determined not by any discomfort due to poor ventilation, but simply by the desire for food.

Many remarkable statements have been made regarding the ventilation of the submarine boats, which have made such marked advances in the past decade. L. Y. Spear, of Quincy, Mass., gives the following information regarding the ventilation of the submarine torpedo boat built by the company of which he is vice-president.

VENTILATION OF SUBMARINE TORPEDO BOATS

In one test one of the boats was submerged for a period of fifteen hours with a crew of six men. The free-air capacity in the interior at about atmospheric pressure was approximately 2,250 cu. ft. No fresh air was supplied nor was any foul

air removed, nor any chemical means of purification used. At the expiration of the test the interior of the boat was somewhat "close," like a "stuffy" room, but there were absolutely no observable bad effects upon the members of the crew. The amount of air supplied each man per minute, according to computations based upon these figures, was about 12 liters (0.42 cu. ft.)

On another occasion, during an official trial at Newport, in June, 1904, the boat was submerged for over twelve hours with nine men on board. No change whatever was made in the air until the expiration of $11\frac{1}{2}$ hours, when the air was renewed by pumping out the foul air and admitting fresh air from compressed stores. This was done merely to demonstrate to the trial board that the apparatus on board for the purpose was satisfactory, and not because there was any discomfort due to the condition of the air. Neither of these tests was carried to its ultimate conclusion, so that we do not know at present just how long a crew could remain without any change in the air supply. Compressed air at 2,500 lbs. per square inch, however, is required for other purposes in the boats, and a sufficient excess of this is carried to change the air in the boat several times.

Obviously, in the case of a submarine boat as well as with the divers, the question of temperature of the water would not have to be considered, as this never could rise to a point producing discomfort. Furthermore, the temperature of the water would in most instances be so low that it would be below the dew-point of the air surrounding the body of the subject, and consequently there would be a condensation of moisture on the walls, thus keeping the relative moisture in the helmet or in the submarine boat at a low point.

Compulsory Regulation of Schoolhouse Construction in the United States

The accompanying chart has been designed by Frank Irving Cooper, a well-known Boston architect, showing the present status of compulsory regulation of schoolhouse construction in this country. This chart was exhibited at the recent meeting of the heating engineers' society and is discussed by Mr. Cooper in the *School Board Journal*.

Mr. Cooper states that the chart is compiled from facts obtained in an investigation made by him during the summer of 1910 of the State laws and regulations in regard to schoolhouse construction. It will be noted that only eight states have passed laws on this subject worthy of the name. Of this number only two, Ohio and Connecticut, have regulations on fireproof construction and only one state, Massachusetts, has passed regulations on fire-retarding construction.

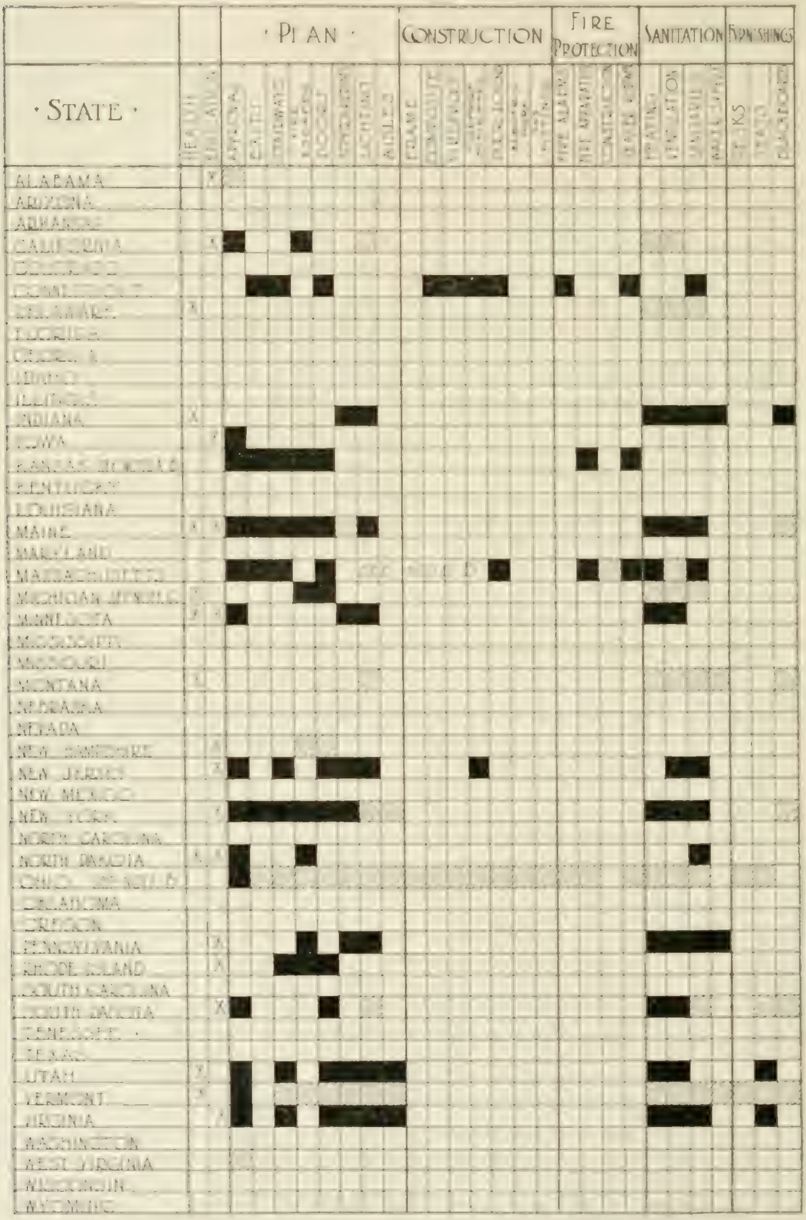
In nine states the control is rested in the boards of health; in thirteen states control through the boards of education, and two states, Massachusetts and Ohio, have regulations through their departments of district police. It should also be noted that the police departments have enforced regulation to a far greater extent than the boards of health and education. Three states have a dual responsibility, as a general principle, but dual responsibility results in confusion and should be deprecated.

In a majority of the cases the regulations state that plans for school buildings must be submitted to a superintendent or other authority for approval.

"This," observes Mr. Cooper, "means a control by men and not by

CHART SHOWING STATUS OF COMPULSORY REGULATION OF SCHOOLHOUSE CONSTRUCTION IN THE UNITED STATES IN 1910.

COMPILED BY FRANK IRVING COOPER, BOSTON



X. SANITARY DEPARTMENT CONTROLLING THE ENFORCEMENT OF THE LAWS.

NOTE A. THE PLANS FOR SCHOOL BUILDINGS IN THIS STATE MUST BE APPROVED BY STATE ARCHITECT.

NOTE B. THESE RULES ARE PREPARED BY THE DEPARTMENT OF INSPECTION OF WORKSHOPS, FACTORIES AND PUBLIC BUILDINGS.

NOTE C. THESE LAWS AND REGULATIONS APPLY TO STATE BUILDINGS ONLY.

■ INDICATES LAW ⬚ INDICATES REGULATION

law; it opens the way to corruption and favoritism or at best to regulations that are changed with the ideas or change of administrators. The present tendency to put the responsibility of making the law on the shoulders of inspectors, commissioners or trustees and the tendency to allow each sub-authority to make rules for his own district is filled with evil possibilities.

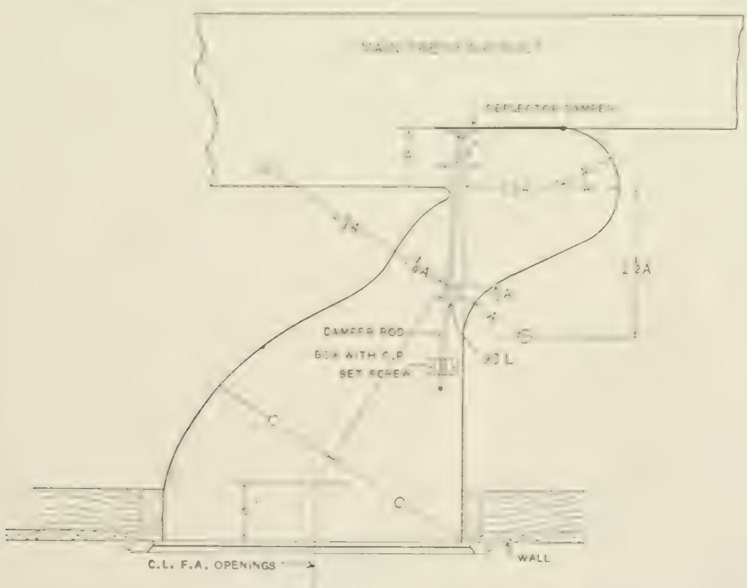
"Each state should pass school-building laws to govern the construction of all of its school buildings, and these laws should be administered by a strong general authority with as many inspectors as may be needed to cover the work."

The Transmission of Air and Its Movement in Ducts

In The Heating and Ventilating Magazine for January, 1911, there appeared an article, under the above heading, by Geo. W. Knight and Perry West, discussing, among other important matters in connection with this subject, the development of a new and efficient method for the distribution of air from the main ducts out to, and through, the fresh air openings to rooms, etc.

of very exhaustive experiments on a full sized duct, with a number of different connections of this general type.

Results of these tests showed that this particular form gives a very even velocity over the entire area of the opening, even with such reductions in velocities of from 1,500 ft. per minute in the main duct, to 250 ft. per minute through the opening.



WORKING DRAWING OF FRESH AIR OPENING USED TO OBTAIN EVEN DISTRIBUTION OF AIR FROM DUCTS INTO ROOMS

We are glad to be able to reproduce herewith a working drawing of the connection used in this method of distribution, and to say that the form shown is the result of a series

The large pocket, into which the air passes as it leaves the main duct acts as an air cushion and reduces the velocity without shock or radical deflection.

The gradually expanding nozzle tends to convert velocity head into static head, thus creating a pressure with expels the air at right angles to the opening into the room. Inasmuch as the static head created is greater than the friction head through the connection, no static pressure is created in the main duct, and, consequently, no extra power is necessary for forcing the air through this connection.

Effect of Concrete on Heating Mains

Instances of the rapid deterioration of heating mains when imbedded in concrete were reported by several speakers at the recent meeting of heating engineers in New York. F. A. Waldron, for instance, stated:

The Chateau Frontenac, Quebec, has recently built an addition of reinforced concrete construction, with cinder fill between the concrete and wood floors. In this cinder fill are imbedded lines of extra heavy galvanized iron pipe. The manager of the hotel showed me two pieces of this pipe, one the size of the original and one a piece that had been in for less than two years. The exterior of the piece that had been imbedded in the cinder had been eaten away, not pitted, but actually laminated, to one-half the thickness of the original pipe. You could take a jackknife and peel off scales of rust from ¼-in. to 1-in. in length.

The cinder concrete was made of ashes and cement and a little sand, the usual mixture. After making a few inquiries I found that the hotel had its own electric light plant, direct current. Evidently that pipe had a leak in it at some point or had been placed in the concrete and allowed to dry. The combination of circumstances there had produced this exterior corrosion.

Mr. A. B. Franklin: I remember a case twenty-five years ago where I told a builder to be sure to keep the cement away from the pipe. "Why," he said, "I have just taken out a steel beam that has been in twenty years and it is as bright and clean as when it was put in." I said, "Oh, yes, that is one thing, but your wrought-iron pipe underneath the floor of this café, where it is going, is no comparison whatever. Don't let that cement come in contact with this pipe." But he was an old builder and could not be told anything, so he laid the pipe in cement. In six months' time the waiters in that café were going around with swollen feet because the floor was so hot. We had to take up the floor and put in brass pipe, although I advised otherwise.

Mr. Waldron: I would like to correct an impression that has gone forth in regard to the laying of pipes in cement. The question that was brought up referred to the use of pipes buried in cinder concrete. Cinder concrete is naturally more or less porous and I presume there is more or less sulphur in the cinders; also its capacity for absorbing moisture is much greater than the ordinary concrete composed of sand and gravel. But, as a general principle, I do not think it would be advisable to imbed pipes subject to expansion and contraction in a solid mass, because in time it would work itself loose. I do not think there is as much trouble with pipe corrosion when buried in a straight concrete of cement and sand and broken stone as when imbedded in a cinder concrete, which is the fill usually used in a concrete building, between the main floor slabs and the wood floor. Tar concrete is much better for this purpose.

Prof. Wm. Kent: In the steel works in Pittsburg many years ago it was a practice to extend the works on made ground and this made ground was composed chiefly of old cinder piles. There it was the universal custom, when running a pipe through that made land, to imbed it in about 1 sq. ft. area of yellow clay, so as to protect it from corrosion due to the sulphur in the cinders. I do not think that pipe should be laid in cinder concrete unless it is thoroughly protected from the cinder concrete.

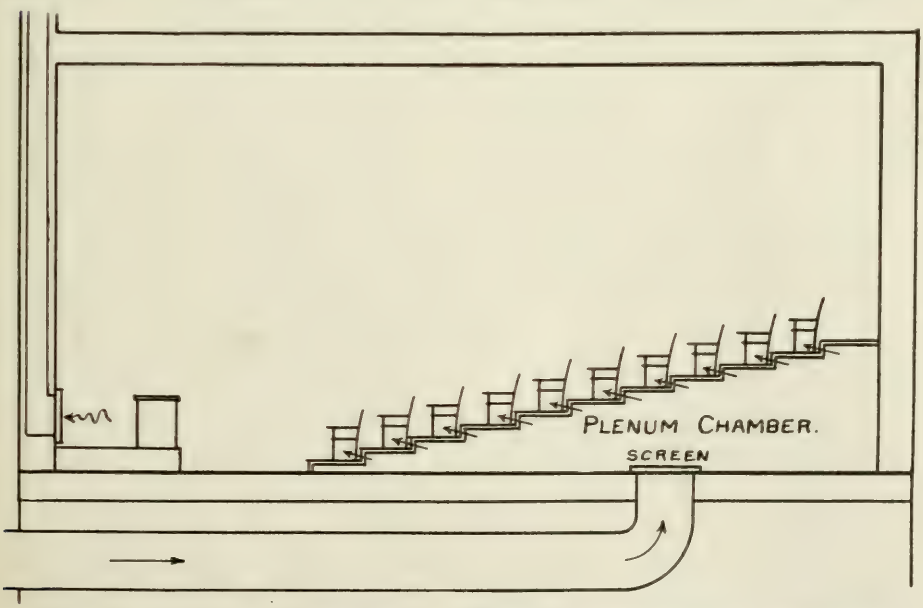
MR. F. K. DAVIS: I have seen electric conduits taken out of cinder cement that were as badly corroded as any pipe shown here to-day. Those pipes were originally coated with an asphaltum compound, but they were simply honeycombed, and it seems to be the opinion of many that free acid in the cement, in addition to the sulphur in the cinder, was the corroding influence.

A Well-Ventilated Assembly Room

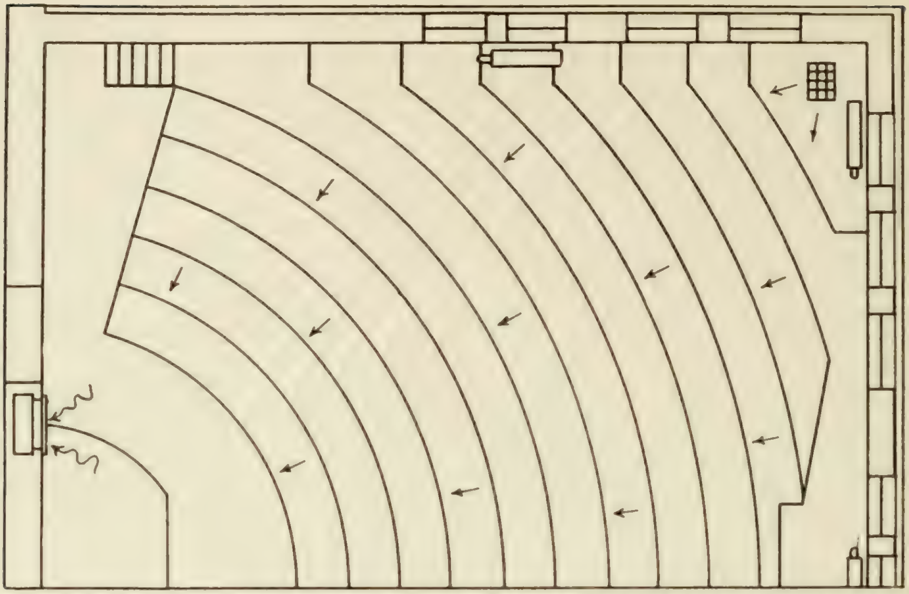
Discussing the matter of air currents in rooms and their effect on ventilation at the recent heating engineers' meeting, Prof. James D. Hoffman cited a case of a particularly-well ventilated lecture room at Purdue University, Lafayette, Ind.

"In some of the lecture rooms at our university," said Prof. Hoffman, "having capacities varying from 300 to 400 students, we have found it a difficult matter to obtain a uniform circulation and distribution of pure air in all parts of the room. In most cases the rooms have raised seats. In our last effort we adopted the old-fashioned scheme of opening up one large duct with a full supply of air into the space below the raised floor, having the air outlets in the rises below the seats, as shown in the accompanying illustration. This space below the raised floor serves as a plenum chamber. The openings into the room are 1-in. diameter and are pitched upward so that the air will not strike the floor. The number of openings is sufficient to permit the required amount of air to enter at a velocity so low that it can scarcely be noticed 1 ft. from the opening. All the air is exhausted at the front of the room near the floor through large registers leading to the attic.

"We have so far made no tests in this room for carbon dioxide, but I know of a number of people who claim to have fair discernment in the matter of pure air, who have come into the room from the fresh outside air on both cold and warm days, and who say that they can detect little or no odor after a class of 300 men have been in the room for an hour. I myself have tried it and I could detect just the slightest odor upon entering. This is a fairly severe test, since the vent registers are located by the side of



A WELL-VENTILATED ASSEMBLY ROOM—SECTION OF ROOM SHOWING VENTILATING SCHEME



A WELL VENTILATED ASSEMBLY ROOM—PLAN OF HALF OF ROOM, SHOWING COURSE OF AIR TO EXHAUST OUTLET

the doors and all the vitiated air passes these points. The circulation at the back part of the room near the top, where we would expect the most impure air, is probably the best.

"This merely goes to show that the practice of admitting the plenum air from underneath the seats through a large number of small openings and withdrawing it from the front of the room by natural circulation to the roof, is giving first-class satisfaction with us."

Over-Dryness of Air and Its Result

A trying condition incident to hot blast heating, and one which as a matter of hygiene should have special attention in hospitals, is the excessive dryness of the air delivered. A high thermometer reading does not necessarily mean a comfortable room. It is the "sensible" heat which should be regarded and this depends upon humidity conditions. An over-dry room will seem chilly because it produces abnormal evaporation from the skin, but at even lower temperatures it will be pronounced comfortably warm if the air is suitably moistened. The average outdoor air in winter has a moisture content of only about 2 grains per cubic foot, and when this air has been carried past steam coils and expanded by the heat it is frequently found to have a relative humidity of but 25 per cent. at 70°.

Much has been said and printed about the debilitating and injurious effects of over-dry air. Unless moisture is artificially added to the supply, it will quickly absorb what moisture it can from anything in the room. This results in an unnatural dryness of the skin and a parching of the throat of every person who is obliged to remain in such atmosphere. While these are only symptoms of discomfort, the cause should not be tolerated because it not only produces headache and mental lassitude, but an irritated condition of the mucous lining of nose and throat which greatly aids the chances of infection from air-borne diseases. From the standpoint of public hygiene, therefore, ventilation should be made either a part of or an adjunct to every heating plant and the ventilating equipment should include a means of cleansing and moistening the air.

Turbine Blower Tests for Forced Draft

Some remarkable results are reported in connection with tests of a turbine blower, made by the Exeter Machine Works, Exeter, N. H., in connection with forced draft for boilers. This blower is so small that the directions for operating it state simply that it should be placed against the side of the boiler, connected to a small steam pipe and set to blow in under the grates. A damper is placed on the discharge to regulate the air supply and deflect it to the ash pit floor, so that the current is uniformly distributed in the chamber. If necessary it has been found practicable to place the turbine in the rear or on top of the boiler or on a bracket on the wall and thence connected with the space underneath the grates.

In one test at the plant of the Boston Woven Hose and Rubber Co., Cambridgeport, Mass., a turbine blower was used on a boiler burning a mixture of anthracite wharf screenings and New River coal in the proportion of 1 to 1. The leading results as to economy were as follows:

Water evaporated per pound of coal as fired, 8.64 lbs.

Water evaporated from and at 212° F., 10.35 lbs.

Cost of fuel used in evaporating 1,000 lbs. of water from and at 212° F. (note high cost of screenings), $0.146.

Reduction of coal cost due to turbine blowers, $27.60 per day.

In a further test at the same plant, data and results were obtained of the evaporation in a 72-in. x 18 ft. horizontal return tubular boiler, with turbine blower, the forced draft registering 1½ in. pressure. The boiler contained 1,614 sq. ft. of heating surface and 36 sq. ft. of grate surface. In this test, made Feb. 21, 1911, wharf screenings and New River coal were used in equal parts:

Duration, hrs.	8
Weight of coal as fired ½ and ½ screenings and New River, lbs.	4,600
Percentage of moisture in mixture	5
Dry coal consumed, lbs.	4,370
Ash, lbs.	685
Percentage of ash in dry coal	15.6
Total water fed and evaporated, lbs.	39,668
Equivalent water evaporated from and at 212° F., hourly quantities, lbs.	4,958
Dry coal per hour, lbs.	546
Dry coal per hour, per sq. ft. of grate, lbs.	24.26
Water evaporated per hour, lbs.	4,958
Equivalent evaporation per hour from and at 212° F., lbs.	5,950
Steam pressure by gauge, lbs.	100
Temperature of feed water, deg. F.	58
Temperature of flue gases, deg. F.	492
Force draft in uptake, in.	0.34
Force of draft in ash pit (1.22 in.-300 cu. ft. per lb. of coal) in.	1.22
Quality of steam (assumed)	Dry
Horse power developed	172.4
Rated H. P. on 12 sq. ft. basis	134.5
Percentage of rated H. P. developed over rating	21.9
Water evaporated under actual conditions per pound of coal as fired, lbs.	8.64
Water evaporated per pound of dry coal, lbs.	9.08
Equivalent evaporation from and at 212° F. per pound of dry coal, lbs.	10.35
Factor of evaporation	1.2000

COST OF EVAPORATION

Cost of coal per ton of 2,240 lbs. delivered in boiler room (screenings $2.80, New River $4, 13,846 B. T. U)	$3.40
Cost of coal required to evaporate 1,000 lbs. of water from and at 212° F.	$0.146

GAS ANALYSIS

CO_2, per cent.	14.8
CO, per cent.	4.2

In this connection the engineer, J. C. Long, states that he has operated a No. 5 turbine blower at 30 lbs. steam pressure and at this pressure the blower has made 605 R. P. M., which would indicate that they can operate successfully at a low steam pressure.

In this plant the reports show that the boilers were burning 378 tons of coal per week costing $1,512 before the turbine blowers were installed, and that the installation reduced these figures to 336 tons of coal costing $1,344, equivalent to a saving of $168 per week and $8,736 per year.

The gases showed 14 per cent. of CO_2.

John F. Hale, vice-president of the Consolidated Engineering Co., Chicago, has resigned and has become associated with Warren Webster & Co., Camden, N. J.

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THOSE who have studied the development of subways as a means of facilitating the movement of people from point to point within the limits of a single city are agreed that it is the coming thing, not only for the larger centers, but for the medium-sized cities throughout the country. Placed in the last few years upon a successful basis as a result of operating and structural devices not before practicable, nearly all of the world's largest cities now possess one or more subways and scores of smaller places are planning them. It is a noteworthy fact that although underground roads were built over fifty years ago, it was not until electric traction became practicable, bringing with it the possibility of good air, that city subways on a large scale were successful. And yet in every case the question of ventilation has been a serious one and has been solved more or less effectively by the use of fans.

This condition of affairs has much of interest for the ventilating engineer, not only on account of its commercial aspects, but also on account of the unusual opportunities afforded for the study of air currents and temperatures under almost every conceivable condition.

An interesting observation, for instance, made by experts after noting a higher temperature in subways constructed some time ago as compared with those built more recently, and operating under similar conditions, is an increase of heat in the older tubes, running from 7° to 10° F. higher than that in the new tubes. The engineers were unanimous in their opinion that the cause of the excessive heating was due to the heavy traffic and to the fact that the capacity of the walls and the surrounding earth to absorb heat becomes, with the passage of time, more and more nearly exhausted. Observations by the managers in one case showed that there was an increase of about 2° F. per year in the temperature of new tubes.

IN ORDER to preserve a proper continuity in the series of articles on central station heating, by Byron T. Gifford, which are commencing in this number, the article on pipe sizes in central station work will be deferred until its logical place is reached in a later issue. Mr. Gifford's first article discusses the matter of line losses and this will be immediately followed, in the May issue, by "Rates in Central Station Heating."

Central Station Heating

I.—PIPE LINE LOSSES.

By Byron T. Gifford.*

THERE are three factors that affect the loss in pipe line operation, and all three are very important: loss from radiation, loss from friction and loss from leaks. These will be taken up separately.

First, Loss from Radiation. This line loss in any underground system is practically constant in steam heating, while in water heating it is proportional to the temperature of the heating medium, and, in both cases, is entirely independent of the per cent. of the capacity being carried in the mains or laterals. In all cases the insulation and pipe line construction affect it to a great extent, especially the drainage of the pipe line to remove, or, better yet, to keep away the surface water or backup water from flooded sewer systems. The depth of the pipe underground also affects the radiation loss.

The author has used as a unit for basing his calculations, 1 sq. ft. of pipe surface underground, including also each square foot of surface in the fittings and specials, such as expansion joints, and all results are given in the radiation loss per square foot of surface per hour. In this work the following table will be found useful for wrought iron and steel pipe:

Size of pipe, inches.	Square feet per lineal foot.
1/8	0.106
1/4	0.141
3/8	0.176
1/2	0.219
3/4	0.276
1	0.344
1 1/4	0.434
1 1/2	0.497
2	0.621
2 1/2	0.752
3	0.916
3 1/2	1.047
4	1.178
4 1/2	1.309
5	1.456

*Vice-President Central Station Engineering Co., Member American Society of Heating and Ventilating Engineers, Junior Member American Society of Mechanical Engineers.

Size of pipe, inches.	Square feet per lineal foot.
6	1.734
7	1.996
8	2.249
9	2.436
10	2.814
12	3.254
14 O. D.	3.665
15 O. D.	3.766
16 O. D.	4.188
18 O. D.	4.712
20 O. D.	4.736
22 O. D.	5.759
24 O. D.	6.283

The above table is derived from the formula:

$$\text{Square feet} = \frac{\text{External Diam. in inches x } \pi}{12}$$

The external surface of the fittings and specials should be calculated. There are so many different sizes and shapes it would be impossible to tabulate their surfaces here. Knowing the number of square feet of surface underground and the amount of heat lost per square foot per hour it is a simple matter to figure the heat lost in any underground system by the formula (H=Heat lost in pounds of steam)

$$H = \text{square feet x } C.$$

Where C is a constant, depending upon the insulation and construction of the pipe line, as well as the temperature of the heating medium.

H. D. Spencer, of Detroit, in Proceedings National District Heating Association for 1910, gives the values for C as follows:

0.051 for 5 lbs. steam lines.
0.086 for 20 lbs. steam lines.

These values are for 4 in. sectional wood log (segmental).

C. R. Bishop, in Proceedings N. D. H. A. for 1910, gives values for C as 0.045, but does not state the pressure or style of insulation. Evidently this value is for the same style of insulation as that reported by Mr. Spencer, but at a lower steam pressure, probably 3 or 4 lbs. These two observations being so close it is probable that the tests were made under about the same conditions.

Tests that the author has made have given him various values for C, from 0.125 to 0.0292, showing a great range of value.

A test on three thicknesses of 2 in. hemlock, with paper lining and shavings, showed, while the insulation was in good physical shape, a value for C as low as 0.0292, but this condition gradually became worse as the insulation became wet and deteriorated. This value is very low and is not often recorded.

The author made a test on the following pipe line with results as follows:

306 ft. 12 in. pipe line.
300 ft. 10 in. pipe line.
481 ft. 8 in. pipe line.
288 ft. 6 in. pipe line.

The value for C was found to be 0.362 during one 98-hour test when the temperature outside was between 20° and 30° F. Steam pressure 3 lbs.

This pipe line was insulated with 1½ in. of asbestos and wool felt and thoroughly water-proofed, as well as underdrained, and this protected on the outside by a 4 in. partition tile conduit, which had a 3 in. air space in it, and placed 4 to 5 ft. underground; i. e., the pipe was 4 to 5 ft. underground.

There is, therefore, only one conclusion we can come to in this case, and that is, that C is a decidedly variable quantity. There is no accurate way of arriving at a value of C except by experiment, but the author uses values given below in his calculations:

Description of insulation and construction	Value of C* Steam; at 5 lbs.	Value of C* Water average
Hemlock lumber, three 2 in. thicknesses, paper and shavings.................1st year	0.03	0.02
Same.............................3rd year	0.05	0.03
Same.............................5th year	0.08	0.06
Same.............................8th year	0.10	0.07
Hemlock lumber, two 2 in. or three 1 in. thicknesses, no paper or shavings......1st year	0.05	0.03
Same.............................3rd year	0.07	0.05
Same.............................5th year	0.09	0.06
Same.............................8th year	0.10	0.07
4 in. segmental wood log, tin lined, well underdrained. 1st year and as long as in good condition..........	0.04	0.025
4 in. concrete conduit, 1 in. covering...........	0.08	0.06
4 in. concrete conduit, 1½ in. covering...........	0.05	0.03
4 in. concrete conduit, 2 in. covering...........	0.04	0.025
4 in. brick conduit, 1 in. covering................	0.08	0.06
4 in. brick conduit, 1½ in. covering..............	0.05	0.03
4 in. brick conduit, 2 in. covering..............	0.04	0.025
4 in. partition tile conduit, 1 in. covering.........	0.07	0.055
4 in. partition tile conduit, 1½ in. covering.......	0.04	0.025
4 in. partition tile conduit 2 in. covering.........	0.034	0.020
Two 1 in. thicknesses lumber with 3 in. concrete envelope................................	0.05	0.03
Tunnel construction 2 in. covering..............	0.045	0.030

*Values of C, are given in lbs. of steam. Multiply this value by 1,000 for heat units value.

All of the foregoing values are used for a dry condition. If wet, it is difficult to assume a value for C.

These values are not absolutely accurate and are not given with that intention, but will be found to be sufficiently correct for estimating purposes.

Some Important Items Affecting Line Loss from Radiation

Drainage. Next to insulation in importance comes underdrainage in its effect on radiation loss. Water will convey heat about eight times as fast as air when confined and for that reason we should try to keep all water, surface or otherwise, away from the insulation and pipe. This can be done by thoroughly waterproofing the conduit and by carrying away whatever water accumulates near the conduit. If the pipe line is laid in a porous soil, such as sand or gravel, the waterproofing of the conduit is sufficient, but in a clay soil some means to carry off the water is necessary.

Lumber insulation will last longer in a clay soil than in a sandy soil, due to the fact that the different conditions of wet and dry will eventually rot the lumber. Lumber under any conditions must be kept dry to be a good heat insulator.

Manholes. Manholes lose more heat per square foot of pipe surface than any other part of the underground system, due of course to the lack of covering. For that reason as few manholes as is consistent should be built. On the other hand, manholes should be over all moving parts such as expansion joints, variators, valves, etc., because of their tendency to leak and cause a very bad condition. A steam leak not only loses heat but it rusts the pipe and deteriorates the insulation and is liable to effect a large section of line before it is discovered.

Heat Losses Due to Leaks. This cause of loss is probably more serious than is at first supposed, according to Napier's Approximate Rule.

$$S = \frac{Pp \times A}{70} = \text{Pounds of steam per second which will pass through a hole.}$$

where Pp = Pressure absolute in the pipe.

A = Area of opening.

$$S = \frac{Pp \times A \times 3600}{70} = \text{Pounds of steam lost per hour.}$$

Assume a ¾ in. hole in a pipe or fitting or assume a number of smaller holes whose aggregate leakage is equal to ¾ in. in diameter in a 5 lb. steam line.

$$S = \frac{19.7 \times .44 \times 3000}{70}$$

= 445.7 lbs. per hour.
= 10,696 lbs. per day.
=320,904 lbs. per month.

Assuming, also, an evaporation of 7 lbs. water per pound of coal we have:

45,843 lbs. coal per month, or 22.9 tons.

From this it is quickly seen that it is absolutely necessary to have a tight pipe line for economical operation.

The same case holds true in hot water heating.

Assume the loss of 1 bbl. or 400 lbs. of water per hour from the flow line at a temperature of 170° F. and under ordinary conditions the water is raised from 40° to 170° F. from the well to the flow line or 130° F.

400 x 130=52,000 B. T. U.

If this leak should be on the return line it would be 400 x 110=44,000 B. T. U. per hour that we would lose, which, assuming 7,000 available B. T. U. per pound of coal, would show us the following result at the coal pile:

1 bbl. leakage per hour from flow line=2.67 tons per month.

1 bbl. leakage per hour from return line=2.19 tons per month.

This shows us the cost of a small leak and it would pay well to fix it and fix it at once.

A tell-tale pump or indicator should be installed on every water pipe line at the station to detect any leak. Very little trouble is to be expected from the loss of water from theft owing to the condition of the water after circulating, but the tell-tale will indicate any leak and should be installed.

Mr. Gifford's next article will appear in the May issue and will discuss "Rates in Central Station Heating."

Reasonable Heating Requirements for New York's Surface Cars

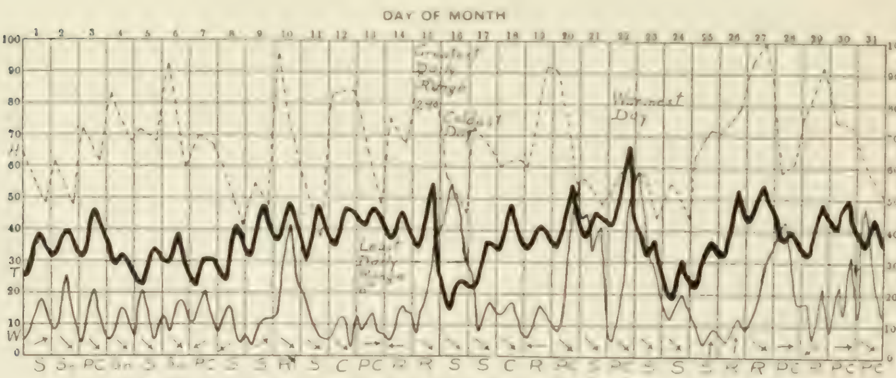
The close of another heating season calls renewed attention to the operation of the heating regulations for New York's surface cars which were promulgated by the Public Service Commission of the First District. Experience has shown that the regulations, which are given in full herewith applicable to electric cars, can be complied with in weather conditions usually prevailing during the winter in New York:

1. All closed cars for the transportation of passengers between the 15th day of October and the 15th day of April in each year shall be equipped with suitable apparatus for heating by electricity.

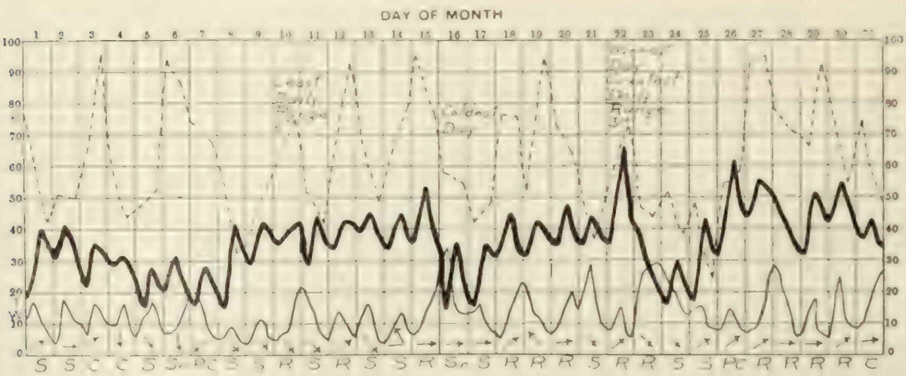
2. Every company during the period above-named, whenever the outside temperature is less than 40° F., shall maintain in all closed cars in service for the transportation of passengers a temperature of not less than 40° F. nor more than 65° F. unless the company is temporarily prevented from so doing by storm, accident or other controlling emergency for which it is not responsible and which is not due to any negligence on its part.

The Weather for March, 1911

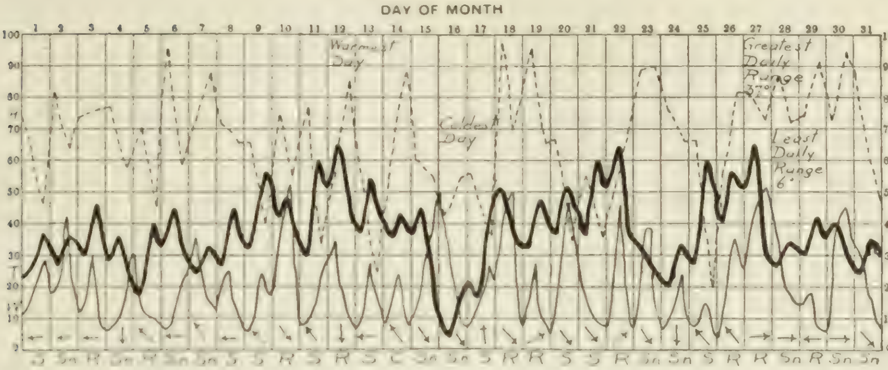
	New York	Boston	Pittsburg	Chicago	St. Louis
Highest temperature, degrees F.....	67	66	66	73	80
Date of highest temperature...........	22	22	12	21	11
Lowest temperature, degrees F........	16	14	4	13	21
Date of lowest temperature.....	16	16	16	16	16
Greatest daily range, degrees F........	[illegible]	31	37	32	38
Date of greatest daily range...........	15	22	27	15	12
Least daily range, degrees F...........	6	6	6	[illegible]	8
Date of least daily range...............	13	10	28	6	7
Mean temperature for month, degrees F.	44.5	35	37	[illegible]	47
Normal mean temp. this month, deg. F.	35.1	35	39.5	34.4	44
Total rainfall, inches.................	2.87	2.95	1.9	1.45	2.22
Total snowfall, inches................	2.8	5.1	7.3	4.9	3.5
Normal precipitation this month, inches	4.1	4.08	3.01	2.55	3.43
Total wind movement, miles..........	11217	9535	11408	11706	9411
Average hourly wind velocity, miles....	15.1	12.8	15.3	15.7	12.6
Prevailing direction of wind...........	N. W.	West	West	South	S. E.
Number of clear days..................	9	13	10	11	15
Number of partly cloudy days.........	14	6	7	9	6
Number of cloudy days...............	8	12	14	11	10
Number of days on which rain fell	11	14	21	10	8
Number of days on which snow fell....	4	2	11	5	2
Snow on ground at end of month, inches.	None	None	Trace	Trace	Trace



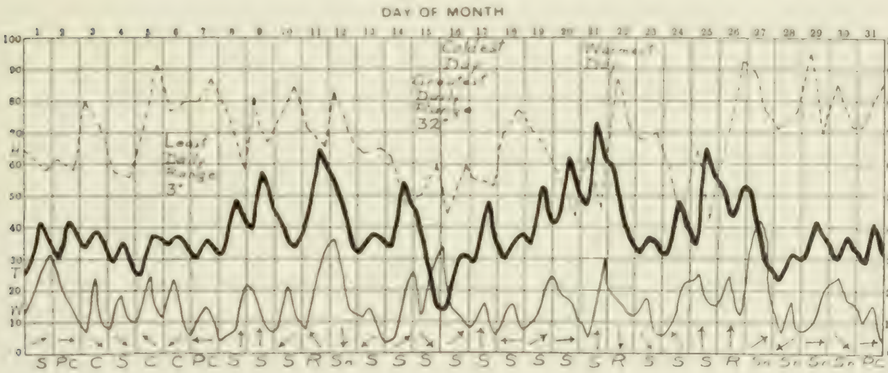
RECORD OF THE WEATHER IN NEW YORK FOR MARCH, 1911



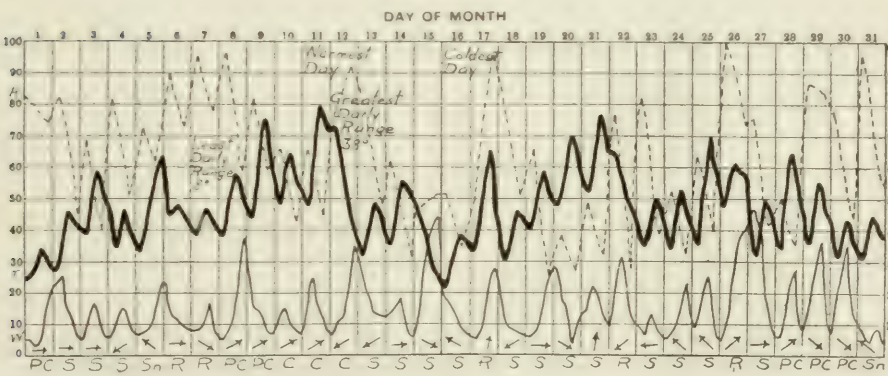
RECORD OF THE WEATHER IN BOSTON FOR MARCH 1911



RECORD OF THE WEATHER IN PITTSBURG FOR MARCH, 1911



RECORD OF THE WEATHER IN CHICAGO FOR MARCH, 1911



RECORD OF THE WEATHER IN ST. LOUIS FOR MARCH, 1911

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate relative humidity in percentage from readings taken at 8 A.M. and 8 P.M.
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—Snow.
Arrows fly with prevailing direction of wind

Legal Decisions

Contract for Installation of Heating Plant—Waiver of Time Limit

An action was brought to recover upon a written contract for the installation of a heating plant of $4,050. The specifications showed a system of heating and ventilating, consisting of fans, engines, heaters, pumps, pipings, etc., to be furnished by the plaintiff, with the exception of some galvanized iron pipe, which was to be furnished by a third party. The contract provided that the plant was to be completed December 1, 1906. It also provided that the defendant was to build the foundations upon which the machinery was to rest, make steam and drip connections from the heaters and engines, do whatever cutting and patching was necessary, furnish common labor and lay tile pipings. It was further agreed that the plaintiff should not be liable for delays occurring without its fault and that "all dates of shipment are contingent upon strikes, accidents or delays of carriers or other causes unavoidable or beyond our control."

The work proceeded in about the usual manner. The defendant, however, asserted that the apparatus was not shipped in good time. The plaintiff answered that the foundations were not ready. The defendant replied that this failure was due to the fact that it could not get the plans from the plaintiff. The work progressed almost to completion, when it was stopped on January 16, 1907, by the defendant because of the alleged insufficiency of the galvanized iron pipe furnished by the sub-contractor. Some of the objections to this pipe were not justified, but the plaintiff was endeavoring to remedy all of the alleged defects when it received a letter from the defendant cancelling the contract.

The position of matters as stated by the court was therefore as follows: The defendant had the plant and had been using it since it was installed; it also had the money it agreed to pay for the plant. The plaintiff had nothing.

The principal contention of the defendant was that the action should have been upon a *quantum meruit* instead of upon the contract, as required by the New York Code of Procedure. The court held that the defect was not vital, as the complaint fully set out the facts, and stated that it would not strain unduly the rules of evidence or of pleading to continue a situation so inequitable.

The delay in completion being due in part to the defendant's action and it having permitted the plaintiff to proceed until near completion, the jury were amply justified in holding the general time limit waived. Judgment for the plaintiff was therefore affirmed.—U. P. Pratt Laboratory vs. Buffalo Forge Co., Circuit Court of Appeals, 184 Fed., 287.

Assignability of Steam Heating Contract

The owner of a large office building entered into a contract with a corporation, whose business was furnishing steam from a central plant for heating purposes, to furnish steam for the building at the rate of 50 cents per 1,000 lbs. of condensation, measured by meter, subject to the following conditions: (a) It was agreed that the total amount of the net bills rendered during any one year should not exceed $1,065; (b) that if, during the life of the contract, the rate charged by the heating company to any consumer in the neighborhood of the owner's premises, consuming as much or less (but not more) steam as the owner, should be less than the rate above specified, the owner's rate should be reduced to such lower rate.

The contract contained various rules and regulations and covered a period of five years with a renewal for a similar period unless cancelled.

About two years and a half after the contract was entered into the owner sold the building to the complainant and assigned in writing the heating contract. The defendant, the heating company, wrote to the complainant that it would furnish steam to the building on a strictly meter basis, and that it had no contract with the owners of the building, enclosing a blank contract for signature. The blank contract was an exact duplicate of the contract with the original owner, except as to the provisions (a) and (b).

The parties were unable to agree. Complainant filed a bill to restrain the defendant from refusing to furnish steam as provided in the original contract. Both parties agreed that the sole question involved in the case was whether the heating contract was assignable and passed, with all its benefits and privileges, to the complainant by virtue of the assignment thereof. The complainant insisted that it was assignable, while the defendant insisted that it was of such a personal character as to be unassignable. The Michigan supreme court held that the contract was assignable.—Voigt vs. Murphy Heating Co.

Supply of Steam for Heating—Rights and Liabilities of Corporation Holding Franchise

A corporation organized to manufacture and sell electric light, heat and power to the occupants of a city secured from the city franchises authorizing it to carry on its business therein. In pursuance of this authority it installed pipes and other appliances through the streets

to supply heat by means of steam. Property owners and occupiers installed in their buildings pipes, radiators and other steam-heating fixtures and appliances which they connected with the company's pipe lines, and for years the company supplied them with steam. During that time these parties obtained electric current for lighting purposes from another electric light company. A leasing company carried on the business of supplying steam which the heating company had contracted to furnish. In 1907 the leasing company served upon consumers a notice to the effect that steam would not be supplied for heating purposes to any party or parties unless they should at the same time use electric current supplied by the heating company for lighting the premises in which steam obtained from that company was used for heating. The plaintiffs brought suit against the heating company and others to enjoin them from enforcing this condition. A defense of the company was that its principal product was electric current for light; that in manufacturing this current during certain portions of the year steam was employed; that the exhaust steam was used in supplying heat; that this exhaust was limited in its amount; that the heat supplied from this source was not more than sufficient to supply patrons of the company who purchased from it current for lighting purposes; and that, if the defendants were required to furnish heat to others than the company's patrons taking light, it would be compelled to generate live steam, which would increase the expense of operating its plant.

Judgment for the plaintiffs was affirmed on appeal. The court said that quasi public corporations like the defendant company must, in consideration of their franchises, serve the inhabitants of their territory without discrimination; but have the right to prescribe for their convenience and security and the protection of the public such rules and regulations, with which their patrons must comply, as are reasonable and just. The condition which the defendant company imposed was an unreasonable and unwarranted one. It was the privilege of its patrons to determine whether they desired one or both of the commodities which the company manufactured and sold, and a condition which imposed an obligation to take both or neither was not only unreasonable, but capricious arbitrary, oppressive and discriminatory.

The defendant company contended that if the steam-heating proposition were to be run independently it could not be operated at a profit and that the defendants should not be compelled to furnish a by-product of the electric light plant unless it was furnished in conjunction with the principal product, electricity. The court held that the business of the company so far as the two products were concerned was separate and distinct. It did not secure a franchise from the city merely to furnish heat from a by-product or exhaust steam, but obtained the right to place and maintain underground lines of pipe under and through the streets "for the purpose of conducting, transmitting and distributing heat, either hot water or steam, for the purchase and use by said city and the residents and citizens thereof." It could not excuse its proposed action on the ground that furnishing steam alone would entail a loss which could be avoided, if electric current were also taken by the consumer for lighting purposes. Neither would it be permitted to impose the condition that a consumer must purchase both of its products in order that its profits might be increased or loss prevented. In passing upon the condition in the notice the court limited its remarks to the condition under the facts of the case relative to the subject under consideration.—Seaton Mountain Electric Light, Heat & Power Co. vs. Idaho Springs Inv. Co., Colorado Supreme Court.

Architecture and Building Show in New York, May 6-13

What is characterized as the first conference of architecural, engineering and building and contracting interests ever held, will inaugurate the opening of the New Grand Central Palace, at Lexington avenue, 46th and 47th streets, New York. The undertaking will be formally known as the New York Architecture and Building Show and will go on during the week of May 6-13, 1911. The show is a movement in the direction of developing a closer relationship between the architectural and engineering interests in the building trades.

Under the lead of a number of professional and technical associations a series of conferences are being planned in connection with the show in which problems confronting architects and engineers will be discussed by experts.

The exhibits already arranged for will be large and varied, assuring the success of the show. They will be designed primarily for the inspection of the professional or technical man rather than the public, although hours will be set aside to admit the public during each day of the exhibit.

The New Grand Central Palace, in which the show will be held, is now approaching completion. It is thirteen stories high and occupies an entire city block, having a floor space of over 600,000 sq. ft. It is described as the largest and handsomest show building in the world, the main auditorium, in which the show will be held, rising to a height of 48 ft.

Small Air Balloons Show Defects in Ventilating System

The Chicago Ventilation Commission has been making some interesting tests at the Chicago Normal School with small hydrogen balloons, which were reported by Samuel R. Lewis, at the recent meeting of heating engineers. The balloons, he stated, were balanced by using as weights old rubber tubing, pieces of which can be easily cut off as required to keep the balloon balanced in the air. These are so sensitive that the warmth given off by a human body causes them to rise when they come near a person. A number of the balloons were released in standard school rooms and the course of the air observed.

According to Mr. Lewis, the balloons demonstrated that horizontal diffusion by vertical diffusers is necessary as the current of fresh air usually would pass the length of the room and strike the opposite wall without spreading to any great extent. They demonstrated that the movement of air took place around the cold sides of the rooms almost entirely, and that the center of the room at the floor line was not getting ventilation to any great extent.

"Two ways of ventilating the center of the room are possible," continued Mr. Lewis, "one by delivering the air at that point, as might be done by upward ventilation; the other, by removing the wall currents, as might be done by constructing our buildings better, so that the drop of the currents down the cold surfaces is equalized enough so that the air out in the rooms moves by the fan or flue influence, pushing in or pulling out evenly over the whole room.

"Dr. Evans, of Chicago, believes in currents, and I am a follower of his. We are studying how to make these currents, which exist in all artifically-heated rooms, serve to produce ventilation. I have changed a large number of my own installations from the ordinary registers (dams which stop the air) to diffusers (curves which divert and direct the air with little friction). I have found the change to result in great improvement, as the fresh air is spread out to all parts of the room with the diffusers and does not pass, as before, over the heads of those in the center of the room, to fall along the opposite wall.

"I think we may yet do away with radiators under windows, when windows are tight and insulated. The radiator so located creates a current in the wrong direction, if we desire to obtain properly diffused ventilation, as they create local upward jets of air drawn from the floor and are constantly opposing any downward ventilation scheme. Then, too, the radiators on outside walls are uneconomical, in my experience, because there is a warm spot on the outside wall opposite every radiator. About one-half of the radiant heat from each radiator goes outside and is wasted. When the radiators are on an interior wall, the radiant heat which goes into the wall is still in the building and warms the same. I have installed, perhaps, fifty ventilated class rooms with the auxiliary direct radiators near the outside walls, but not parallel with or against them, and have heard no complaint on account of draft."

To Determine Water Vapor in Air at Different Heights

Announcement is made that the United States Weather Bureau has made progress toward the installation of apparatus, especially optical, for the study of the quantity of water vapor through a wide vertical extent of the atmosphere (as distinguished from the purely local indications of the hygrometer and the psychrometer). Spectroscopic observations with this end in view are to be undertaken by Prof. W. J. Humphreys.

Importance of Outdoor Air Test When Testing for CO_2 Indoors

It is highly important in testing indoor air for the amount of carbon dioxide it contains to have some knowledge of the proportion of carbon dioxide in the air supply. In some tests made of the outside air on the roof of the Custom House in New York City, Mr. Cooley, of the Supervising Architect's Department, found that at this point, which is near the Battery and presumably pretty well wind-swept, the proportion of CO_2 in the outside air ran as high, I think, as 7 parts in 10,000. The importance of this phase of the subject has been recognized in the proposed new law for factory ventilation in New York State. The committee having this matter in charge had to bow to the wishes of other interests which contended that carbon dioxide should be recognized as the vital element in ventilation and we settled on a differential. It complicates the matter by making it necessary to test both the indoor and outdoor air.—*W. W. Macon, before the Heating Engineers' Society.*

Names of Manufacturers Wanted by Illinois Department of Factory Inspection

In connection with the Illinois factory law, which covers, among other things, the matters of heating and ventilation, it appears that many manufacturers in Illinois, although acquainted with the statute, and desirous of complying therewith, have lacked definite information as to how to secure the appliances called for.

To supply this information and thus expedite compliance with the law, the chief factory inspector of Illinois, Mr. Edgar T. Davies, is compiling a list of makers of all appliances used in accordance with this statute. This includes manufacturers of ventilation and sanitation apparatus.

All such manufacturers are requested to send in their names, addresses and list of their appliances, addressing same to Edgar T. Davies, Chief Factory Inspector, Illinois Department of Factory Inspection, 1103 Security Building, Chicago, Ill. The information thus sent in will be published, we are advised, without discrimination of display or position, and with absolutely no expense to any manufacturer represented, the entire expense being borne by the State.

To those who are not familiar with the Illinois factory law, it may be stated that it is entitled, "An Act to provide for the health, safety, and comfort of employees in factories, mercantile establishments, mills and workshops in this State, and to provide for the enforcement thereof." It was approved June 4, 1909, and became effective January 1, 1910.

The sections relating to ventilation and sanitation are as follows:

"Sec. 10. In every factory, mercantile establishment, mill or workshop, where one or more persons are employed, adequate measures shall be taken for securing and maintaining a reasonable, and, as far as possible, equable temperature, consistent with the reasonable requirements of the manufacturing process. No unnecessary humidity, which would jeopardize the health of employees, shall be permitted.

"Sec. 11. In every room or apartment of any factory, mercantile establishment, mill or workshop, where one or more persons are employed, at least 500 cu. ft. of air space shall be provided for each and every person employed therein, and fresh air, to the amount specified in this act, shall be supplied in such a manner as not to create injurious drafts, nor cause the temperature of any such room or apartment to fall materially below the average temperature maintained; provided, where lights are used which do not consume oxygen, 250 cu. ft. of air space shall be deemed sufficient. All rooms or apartments of any factory, mercantile establishment, mill or workshop, having at least 2,000 cu. ft. of air space for each and every person employed in each room or apartment, and having outside windows and doors whose area is at least one-eighth of the total floor area, shall not be required to have artificial means of ventilation; but all such rooms or apartments shall be properly aired before beginning work for the day and during the meal hours. All such rooms, or apartments, having less than 2,000 cu. ft. of ar space, but more than 500 cu. ft. of air space, for each and every person employed therein, and which have outside windows, and doors whose area is at least one-eighth of the floor area, shall be provided with artificial means of ventilation, which shall be in operation when the outside temperature requires the windows to be kept closed, and which shall supply during each working hour at least 1,500 cu. ft. of fresh air for each and every person employed therein. All such rooms or apartments, having less than 500 cu. ft. of air space for each and every person employed therein, all rooms or apartments having no outside windows or doors, and all rooms or apartments having less than 2,000 cu. ft. of air space for each and every person employed therein, and in which the outside window and door area is less than one-eighth of the floor area, shall be provided with artficial means of ventilation, which will supply during each working hour throughout the year at least 1,800 cu. ft. of fresh air for each and every person employed therein; provided, that the provisions of the preceding portions of this section shall not apply to storage rooms or vaults; and, provided further, that the preceding portions of this section shall not apply to those rooms or apartments in which manufacturing processes are carried on which from their peculiar nature would be materially interfered with by the provisions of this section. No part of the fresh air supply required by this section shall be taken from any cellar or basement.

"The following terms of this section shall be interpreted to mean: The air space available for each person is the total interior volume of a room expressed in cubic feet, without any deductions for machinery contained therein, divided by the average number of persons employed therein.

"Outside windows and doors are those connecting directly with the outside air; the window and door area is the total area of the windows and doors of all outside openings; and the floor area is the total floor area of each room.

"Sec. 12. All factories, mercantile establishments, mills or workshops shall be kept free from any gas or effluvia arising from any sewer, drain, privy or other nuisance on the premises. All poisonous or noxious fumes or gases arising from any process, and all dust of a character injurious to the health of the persons employed, which is created in the course of a manufacturing process, within such factory, mill or workshop, shall be removed, as far as practicable, by either ventilating or exhaust devices.

"Sec. 13. All decomposed, fetid or putrescent matter, and all refuse, waste and sweepings of any factory, mercantile

establishment, mill or workshop, shall be removed and disposed of, at least once each day, and in such a manner as not to cause a nuisance; and all cleaning shall be done, as far as possible, outside of working hours; but if done during working hours, shall be done in such a manner as to avoid the unnecessary raising of dust or noxious odors. In every factory, mill or workshop, in which any process is carried on which makes the the floors wet, the floor shall be constructed and maintained with due regard to the health of employees, and gratings or dry standing rooms shall be provided, if practicable, at points where employees are regularly stationed, and adequate means shall be provided for drainage, and for preventing seepage or leakage to the floors below.

"Sec. 28. The provisions of this act relating to sanitation and ventilation shall not be held to apply to such rooms or apartments of any factory, mercantile establishment, mill or workshop, which are being operated under the supervision of the Federal Government, by virtue of an Act of Congress, entitled 'An Act making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1907," approved June 30, 1906, or any amendment thereof; nor shall any other of the provisions of this act so apply respecting matters and conditions over which the Federal Government now exercises or shall hereafter exercise jurisdiction."

The law provides that "anyone who shall violate any of the provisions of this Act shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished for the first offense by a fine of not less than $10 and not more than $50, and upon the conviction of the second or subsequent offense shall be fined not less than $25 and not more than $200, and in each case shall stand committed until such fines or costs are paid, unless otherwise discharged by due process of law.

The Present Status of Ventilation Requirements in Massachusetts

Speaking at the recent heating engineers' meeting Joseph A. Moore, inspector of public buildings and deputy chief of the Inspection Department, State of Massachusetts, gave an interesting summary of the situation with regard to the ventilation requirements in Massachusetts, which are now on a somewhat different basis from those which have been in effect for many years.

"In Massachusetts," said Mr. Moore, "we were very glad to start in and get what we could at first. The first laws were in rather a crude shape and gradually we kept working for more points. Finally we got a law that worked well until the medical inspectors of the State Board of Health stepped in and for two years deprived us of all authority. Our law now is different from what is generally understood. We have nothing to do at the present time with factories and work-shops. We did have until the authority was taken away from us in 1907, but in 1909 we got back part of our jurisdiction in connection with public buildings."

The law covering this reads:

"Every public building and every school house shall be kept clean and free from effluvia arising from any drain, privy or nuisance, shall be provided with a sufficient number of proper water closets, earth closets or privies, and shall be ventilated in such a manner that the air shall not become so impure as to be injurious to health. If it appears to an inspector of factories and public buildings that further or different sanitary, ventilating or heating provisions are required in any public building or schoolhouse, in order to conform to the requirements of this section, and that such requirements can be provided without unreasonable expense, he may issue a written order to the proper person or authority, directing such sanitary, ventilating or heating provision to be provided.

"A school committee, public officer or person who has charge of, owns or leases any such public building or schoolhouse, who neglects for four weeks to comply with the order of such inspector, shall be punished by a fine of not more than $100.

"Whoever is aggrieved by the order of an inspector, issued as herein provided and relating to a public building or schoolhouse, may appeal to a judge of the superior court, as provided in Chapter 487 of the Acts of the year 1908."

"I will say," continued Mr. Moore, "that the law is that the judge may either hear the case or he may appoint three disinterested persons skilled in the subject matter of the controversy. It allows the calling in of engineers or people that are competent to pass on it."

Inspection on the part of the State Board of Health is made under the following authority:

"The State Inspectors of Health or such other officers as the State Board of Health may from time to time appoint shall make such examinations of school buildings as in the opinion of said board the inspection of the health of the pupils may require. The provisions of this section shall be enforced by the State Inspectors of Factories and Public Buildings."

"There was another law," added Mr. Moore, "enacted in 1909, which gave us more authority. It is contained in Chapter 354, Acts of 1909, and reads:

"The Chief of the District Police, the Deputy Chief of the Inspection Depart-

ment of the District Police, and the Inspectors of Factories and Public Buildings may, in the performance of their duty in enforcing the laws of the Commonwealth, enter any building, structure or enclosure, or any part thereof, and examine the method of prevention of fire, means of exit and means of protection against accident, and may make investigations as to the employment of children, young persons and women, except concerning health and the influence of occupation upon health. They may, except in the city of Boston, enter any public building, public or private institution, schoolhouse, church, theatre, public hall, place of assemblage, or place of public resort, and make such investigations and order such structural or other changes, in said building as are necessary, relative to the construction, occupation, heating, ventilating and the sanitary condition and appliances of the same.

"'Any person who hinders or prevents or attempts to prevent any member of the Inspection Department of the District Police from entering any building, structure or enclosure or part thereof specified in the preceding section shall be liable to a penalty of not less than $50 nor more than $100.'

"Our department years ago established a standard. It is not law in Massachusetts, but it has been practically accepted. It is practically that there shall be at least 30 cu. ft. of fresh air supplied per minute for each occupant of a school room, and at least that amount of vitiated air removed through the vent ducts, the temperature not to vary more than 3° F. at any occupied part of the room. We generally place our thermometers upon the corner desks and on the teacher's desk, making five thermometers. No uncomfortable draft is to be perceptible and no unsanitary odors shall be noticed in the building and the building must be heated to 70° F. in any weather. Those requirements have been in force for years and are generally observed under that provision of the law conferring on the District Police the authority for enforcing the law."

MR. JAS. H. DAVIS: I would like to ask if that Massachusetts law applies to parochial and private schools?

MR. MOORE: Our law applies to schools seating 10 or more persons at one time. A section of our law reads:

"No building which is designed to be used, in whole or in part, as a public building, public or private institution, schoolhouse, church, theatre, public hall, place of assemblage or place of public resort, and no building more than two stories in height, which is designed to be used above the second story, in whole or in part, as a factory, workshop or mercantile or other establishment and has accommodations for ten or more employees above said story, and no building more than two stories in height designed to be used above the second story in whole or in part as a hotel, family hotel, apartment house, boarding house, lodging house, or tenement house, and has 10 or more rooms above said story, shall be erected until a copy of the plans thereof has been deposited with the inspector of factories and public buildings for the district in which it is to be erected by the person causing its erection, or by the architect thereof. Such plans shall include the method of ventilation provided therefor, and a copy of such portion of the specifications therefor as the inspector may require. Such building shall not be so erected without sufficient egresses and other means of escape from fire, properly located and constructed.

"The certificate of the inspector, endorsed with the approval of the Chief of the District Police, shall be conclusive evidence of a compliance with the provisions of this chapter unless, after it is granted, a change is made in the plans or specifications of such egresses and means of escape without a new certificate therefor. Such inspector may require that proper fire stops shall be provided in the floors, walls and partitions of such buildings, and may make such further requirements as may be necessary or proper to prevent the spread of fire therein or its communication from any steam boiler or heating apparatus.

"Sec. 23. No wooden flue or air duct for heating or ventilating purposes shall be placed in any building which is subject to the provisions of Sections 24 and 25 (the sections refer to buildings such as those already described, coming under the inspection of the fire inspectors), and no pipe for conveying hot air or steam in such building shall be placed or remain within 1 inch of any woodwork, unless protected to the satisfaction of said inspector, by suitable guards or casings of incombustible material.

"Sec. 24. Whoever erects or constructs a building, or architect or other person who draws plans or specifications, or superintends the erection of a building, in violation of the provisions of this chapter shall be punishable by a fine of not less than $50 or more than $1,000."

Ohio Society of Mechanical, Electrical and Steam Engineers

The next semi-annual meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers will be held in Youngstown, Ohio, on May 18 and 19. Oscar F. Rabbe, Toledo, president; Prof. Frank E. Sanborn, Columbus, secretary-treasurer.

CORRESPONDENCE

New Building Inspection Bill Before Massachusetts Legislature

EDITOR HEATING AND VENTILATING MAGAZINE:

Since the meeting of The American Society of Heating and Ventilating Engineers in New York last January, there has been sent to the Massachusetts legislature a report from a commission appointed last year by Governor Draper and which consisted of a lawyer, a doctor and a woman connected with a women's society, a labor leader and a representative of manufacturers. The commission held meetings last year in different cities at which labor representatives, children's aid society's paid representatives, some general reform doctors, agitators, and part of the inspectors of the district police were present.

The report was very erroneous and misleading and presented to the legislature a bill which provides for an unpaid commission of five members who would have the appointment of a chief commissioner, two deputies, a register and fifty inspectors, ten of which would be women, and women inspectors, many of whom would be physicians. The salary of the commissioner to be not less than $6,000 or more than $8,000. The salary of the others to be fixed by the unpaid commission and to be paid out of the State treasury. The commissioners were to fix the terms of office and could remove at any time any member by a vote of four members.

This bill proposes to give an unpaid commission, to be appointed by the Governor, absolute power. The commission could fix salaries at any sum it desired and the State treasury would be obliged to pay the amount so fixed without requiring the legislature to make an appropriation. The bill also proposes to discharge all the inspectors of factories and public buildings, except the chief and deputy chief. Of the 28 inspectors to be discharged 18 are to be reappointed as building inspectors. This would reduce the number of inspectors by 10 and would turn out men who have had many years of practical experience (some over 20 years), men who are architects, builders and practical experts in heating and ventilation. Also, some who are veterans of the Civil War and who, in that event, could not go upon the veterans' retired list as they can now go.

The bill creates a large force of inexperienced men. Whatever knowledge a man may have as a physician would not qualify him as an expert in matters of heating and ventilation. What could he tell about heating and ventilating plans or specifications? Could a doctor figure the size of boilers, radiation, pipes, valves, sizes and locations of supply and exhaust ducts for ventilation, the sizes and speeds of fans or electric motors and many other things required by a heating and ventilating engineer or contractor?

The bill proposes that these new men have charge of the construction, heating, ventilation and sanitation of all buildings used for industrial purposes, which include factories, workshops, bakeries, mechanical establishments, tenement-house workrooms, and all other buildings in which manufacturing is carried on, and mercantile establishments.

This will create a conflict between the new men and the building inspectors of the district police. Many buildings used on the first floor for mercantile purposes have on the floor above, public halls, moving picture houses, theatres, assembly and lodge rooms that require modern ventilation. This bill will give the doctors authority to approve the building plans and, if they see fit, will allow buildings to be constructed without proper means of exit or means of preventing spread of fire, or having proper and sufficient means of heating and ventilation. All of which are required for the protection and health of the public.

This bill is favored and urged by the same parties who were instrumental in taking from the district police inspectors all authority in matters of heating, ventilation and building construction, and transferring the work to the medical inspectors of the State Board of Health.

The Boston Socety of Architects has appointed a committee which has stated that it is its object to reduce the cost of heating and ventilating apparatus; also to reduce the size of flues for supplying and removing air and also the amount of air supplied. At a meeting of this committee of the architects' association, several doctors were invited to be present, and it was proposed to adopt the practice of ventilating by windows instead of by modern appliances, especially in schools.

The legislature has not yet acted on the proposed bill to establish the industrial inspection department, but its advocates are busily engaged in influencing all the persons they can in favor of the measure. It appears to be theory versus practical knowledge and experience. The chances are, however, that the bill will not pass the legislature.

MEMBER A. S. H. & V. E.

Boston, April, 1911

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Change of Date for Annual Convention

Announcement is made of a change in date of the annual convention of the National Association of Master Steam and Hot Water Fitters which will meet in Chicago. The original dates selected were in June, and the new dates selected are May 29, 30, 31 and June 1, 1911. Headquarters will be at the Hotel Sherman, Randolph and Clark streets. Under the first arrangement the convention would have conflicted with that of the National District Heating Association, which meets in Pittsburg early in June.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

For a Summer Meeting on Lake Michigan

A plan to hold the next summer meeting of the Heating Engineers' Society on the waters of Lake Michigan, first proposed by former Vice-President Samuel R. Lewis, in an after-dinner speech at the meeting of the society in St. Louis last summer, now promises to become a reality. At a meeting of the board of governors of the society, held in the society's headquarters in the Engineering Societies' Building, New York, March 24, the proposal was made to hold the summer meeting on June 27, 28 and 29, 1911, on a three-days' steamship trip on Lake Michigan and Green Bay, and it was decided to canvass the members to learn if a sufficient number could be counted on. Tentative arrangements have been made to charter one of Lake Michigan's leading steamships. The meeting thus promises a highly attractive outing feature. Special entertainment is planned for the three evenings taken up in the journey; proper periods of morning or afternoon are reserved for the technical sessions and a considerable number of stops at important cities and interesting places with perhaps an hour's sojourn in each case are possible.

Twenty-five applications for membership were received by the board and approved for ballot vote.

It was voted to issue during the present year the proceedings of 1909 and 1910. On account of the unusual expenditure involved, it is desired that the increased outgo shall not make inroads on the society's surplus reserve, and it was voted to make an appeal to each member to introduce a candidate before the summer meeting.

National District Heating Association

The committee on data of the National District Heating Association, through E. J. Kiefer, chairman, 31 North 9th street, Easton, Pa., has sent out blank forms to members in an effort to collect information to be included in its report at the forthcoming meeting of the society in Pittsburg, June 5-8. The data desired refer to both steam and hot water central station heating work and cover the number of consumers, rates, number of meters in service, price of domestic fuel, amount of space heated, amount of radiation, rules governing installation, design of system (whether operated in connection with an electrical supply company) and whether the business is profitable at the rates charged. Additional details are asked for various classes of buildings, the points including the total amount of space, total radiation, ratio of radiation to space, average cost per 100 cu. ft. of space, average cost per square foot of radiation, monthly average temperature and monthly average coal consumption.

National Association of Jobbers of Wrought Iron Pipe and Fittings

An attendance of 125 members was registered at the second annual convention of the National Association of Jobbers of Wrought Iron Pipe and Fittings, which was held at the Hollenden Hotel, Cleveland, O., March 14 and 15 last. The organization reported a total membership of 220, representing 90% of the tonnage in pipe and fittings handled by jobbers.

The meeting was presided over by President A. E. Ford, of Ford & Kendig Co., Philadelphia, and the two-days' programme was taken up with reports and topical discussions of various phases of the jobbing business. Among the speakers were W. B. Henion, Chicago; W. M. Pattison, Cleveland; W. L. Rodgers, Pittsburg; J. P. Fell, Buffalo; George W. K. Taylor, New York, and Francis J. Baker, San Francisco.

The following officers were elected: President, C. H. Simmons, John Simmons Co., New York; first vice-presdent, O. F. Felix, Pittsburg Gauge & Supply Co., Pittsburg; second vice-president, A. L. Scott, Pacific Hardware & Steel Co., San Francisco; treasurer, C. G. Cornell, Jr., Cornell & Underhill, New York; advisory secretary, T. James Fernley, Philadelphia; secretary, Thomas A. Fernley, Philadelphia; members of executive committee, W. M. Pattison, Cleveland; F. M. Sheldon, Boston; E. G. Cuyler, Baltmore; C. V. Kellogg, Chicago; Samuel H. Moon, Louisville, and J. P. Hartnett, St. Louis.

Atlantic City was selected as the meeting place for the association in 1912.

Features of the convention were an inspection of the plant of the National Tube Company, at Lorain, O., and a theatre party at the Hippodrome in Pittsburg.

Warren Webster & Co.'s Twenty-Third Anniversary

Upon the occasion of the twenty-third anniversary of the establishment of the business, Warren Webster & Co., Camden, N. J., held a convention of its district managers and engineers from March 6 to 11, 1911. Headquarters were established at the Bellevue-Stratford Hotel, Philadelphia, where the convention was formally opened by a dinner in the evening of March 6, at which covers were laid for forty-six.

A large convention hall was engaged in the Camden Y. M. C. A. building, where morning, afternoon and evening sessions were held for a period of five days, during which an elaborate and carefully prepared program of problems connected with the fields of vacuum steam heating, modulation systems, feed-water heaters and air washers was discussed. Suitable general papers were read by those in charge of the respective departments, while the details were covered in a series of topical discussions.

It was the purpose of the company, through this convention, not only to educate their organization fully in all of the developments which have taken place, but to formulate standards so that the Webster practice would be uniform in all of the sections of the country covered by its twenty-three branch offices.

William G. Snow, chief engineer of the company, officiated as chairman of the convention and conducted it strictly according to parliamentary practice. An interesting incident was the presentation to Warren Webster, president of the company, of a handsome silver loving cup, by the district managers.

The photograph shows the delegation while guests of the company at the opening dinner.

Boston's Congress of Technology

The fiftieth anniversary of the granting of the charter to the Massachusetts Institute of Technology was made the occasion of a Congress of Technology in Boston, April 10 and 11. The sessions of the Congress were held in the building of the Institute of Technology, being opened with an address by President Maclaurin, of the Institute, in Huntington Hall. On this and the following day, April 11, an imposing array of papers was presented in the various buildings of the institute, covering practically the entre range of the technical field.

Among the papers of special interest to the heating and ventilating profession were the following:

DINNER TO WARREN WEBSTER & CO.'S ORGANIZATION AT OPENING OF 1911 CONVENTION ON OCCASION OF COMPANY'S TWENTY-THIRD ANNIVERSARY

"Factory Sanitation and Efficiency," by C. E. A. Winslow, Associate Professor of Biology, College of the City of New York.

"Thirty Years' Work in Boiler Testing," by George H. Barrus, Boston.

"The Technical School Man in Public Health Work," by Harry W. Clark, Chief Chemist, State Board of Health, Boston.

The Nason-Vesusvius Steam Trap

In a certain sugar refinery a series of four vacuum pans were all drained into one trap. There was need for increased capacity and talk of installing a fifth kettle to supply the demand. The engineer taking the tip of an engineer salesman suggested drawing each kettle independently and putting a trap on each outlet so that the steam coils could be freed from water as soon as it had condensed. His suggestion was carried out and an increased output of each sugar pan made the total capacity of four pans, with independent steam traps, equal to four and one-half pans with the single trap drain. The cost of the four traps

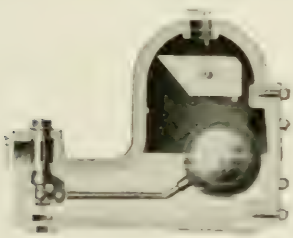


FIG. 1—NASON-VESUVIUS STEAM TRAP, SHOWING BUCKET IN RECEIVING POSITION, VALVE CLOSED

was about one twenty-fifth that of a new pan.

In kiln work and under all conditions where steam is used for drying or cooking purposes, the secret of success is to condense the steam as quickly as possible and get rid of the water immediately.

It will thus be seen that the efficient system is one which is quickly freed from all condensation so that the water can be immediately discharged into the hot well and returned to the boiler, changed into steam and given another charge of a thousand heat units per pound. Among the better class of steam traps is the type known as the Nason-Vesuvius, made by the Nason Manufacturing Company, New York.

Fig. 1 shows the Nason-Vesuvius steam trap in its receiving position; Fig. 2 shows it relieving the system of a charge of water.

The operation of the trap is as follows: Water enters the trap at "inlet" (Fig. 1 and is received in the tilting copper bucket (a). This bucket when empty is maintained in a horizontal position as shown, but when full of water it becomes unbalanced and dumps its charge of water into the body of the trap (Fig. 2). The quick upward impulse imparted to the float C by this discharge instantly removes the ball from its seat. This instantaneous action of the ball in leaving

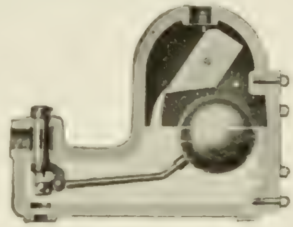


FIG. 2—NASON-VESUVIUS STEAM TRAP SHOWING BUCKET DUMPING VALVE DISCHARGING

its seat allows a clear free-way for the discharge.

In closing, the float follows the receding water level and gradually returns the ball toward its seat until a predetermined level is reached. At this point the pressure "picks up" the ball and instantly seats it, thus closing the discharge orifice, until the above described operation is repeated.

As will be observed from the large detail of the valve (Fig. 3) the ball is held in position by cage D (Fig. 1). The stationary and movable pins comprising this cage are so arranged that a positive rotating motion is imparted to the ball with each discharge, thus offering a different surface of the ball at each seating.

It will also be observed that if at any

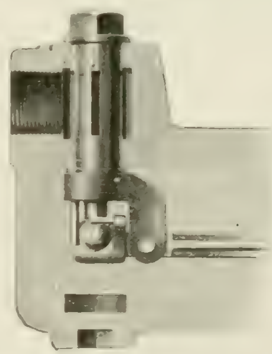


FIG. 3—ENLARGED VALVE DETAIL OF NASON-VESUVIUS STEAM TRAP

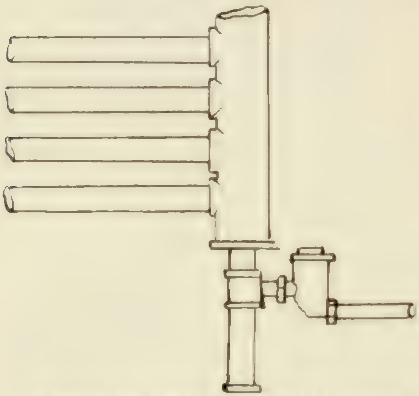
time it is necessary to repair the trap, a new ball and seat can be put in in a few minutes' time and at a very small cost.

Catalogues containing very full descriptions of this trap as well as of the company's other specialties will be sent to those asking for them by the Nason

Manufacturing Company, 71 Fulton street, New York. The company also offers the services of its engineering department in solving any trap problem which may confront the engineer.

Heating System for the Doherty Silk Mill, Paterson, N. J.

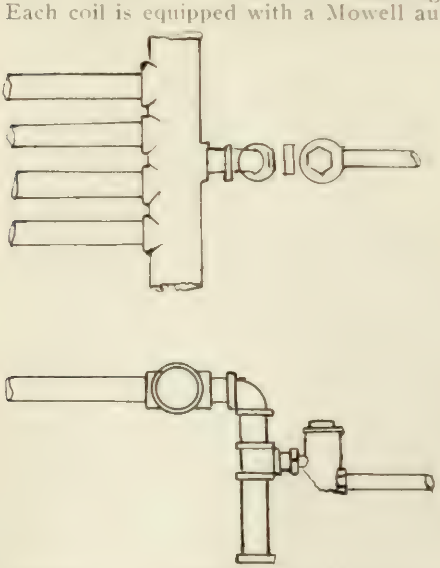
The Doherty Silk Mill, in Paterson, N. J., is a four-story building of unusual length, measuring no less than 466 ft. 8 in. by 55 ft. wide. The heating throughout is by means of direct steam coils,



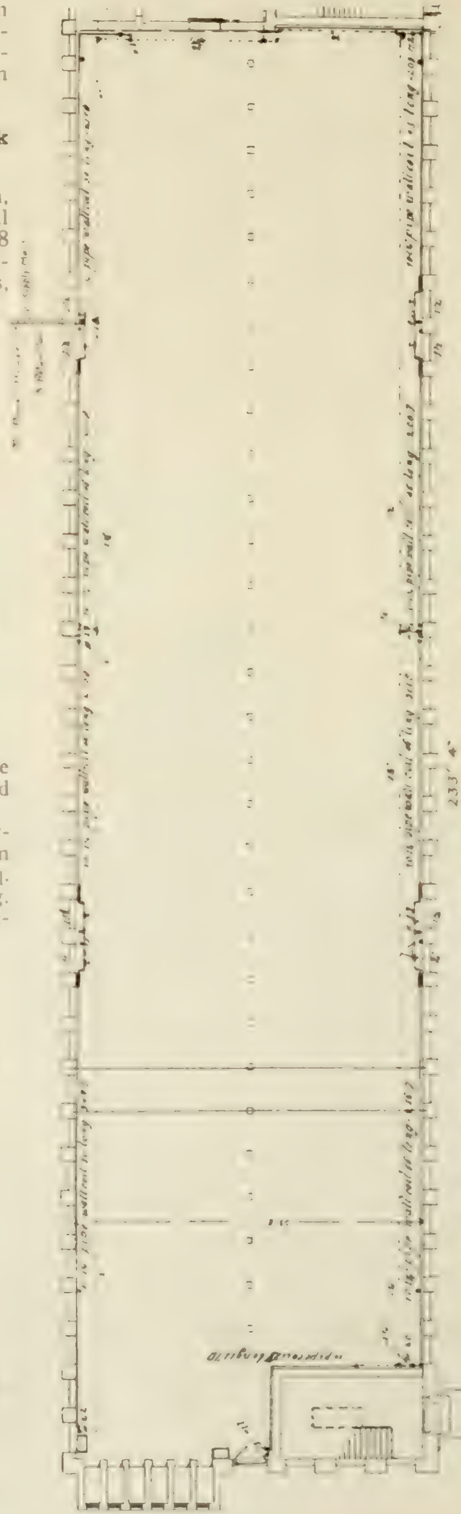
METHOD OF DRIPPING WALL COILS
DOHERTY SILK MILL

supplied with exhaust steam from the power house, situated directly behind the mill.

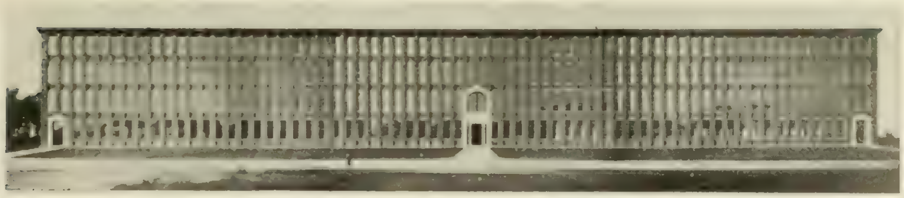
Steam at atmospheric pressure is circulated by means of a 6x8x12 in. vacuum pump, operating on a total of 19,000 sq. ft. of radiation in the entire building. Each coil is equipped with a Mowell au-



METHOD OF DRIPPING OVERHEAD COILS.
DOHERTY SILK MILL



PART PLAN OF FIRST FLOOR DOHERTY SILK MILL, PATERSON, N. J. SHOWING HEATING SYSTEM



DOHERTY SILK MILL, PATERSON, N. J.

tomatic relief valve, 86 of these valves being included in the installation.

The general layout of the system may be noted from the accompanying typical part floor plan. The main riser is run to the fourth floor ceilng and thence to the branch risers, the system being down feed. A notable feature of the layout is the small sizes of the return risers made possible by the use of the Mowell type of valve.

The system was designed and installed by Augustus Mowell, Paterson, N. J., and has been in operation one winter during which time it has operated with unusual success.

Improved Expansion Joint

A new type of packingless, diaphragm expansion joint has recently been placed on the market by the Central Station Steam Co., of Detroit, Mich. The accompanying interior view of a double joint shows the construction and method of operation.

The double joint consists of two annular diaphragms of heavy cold-rolled and annealed copper, clamped at their outer edges between a cast iron "inner-ring" and two cast iron "outer-rings" and having their inner edges spun through and around the inner edges of the cast iron "backing-rings." The copper is brought far enough up on the outside face of the backing-ring to permit of clamping it securely between the backing-ring and the "slip-end" which is a short, flanged cast iron nipple. The outer-ring, inside of which and concentric with which the backing-ring is located, is recessed to a depth considerably in excess of the thickness of the backing-ring.

In operation, the joint is placed in the pipe-line with the slip-ends and backing-rings drawn out to their farthest limit. The inner-ring and outer-rings are rigidly anchored, by cast-iron lugs, into the concrete or brick box built around the joint, and service-pipes to the buildings on each side of the street are connected to the service-outlets. As the pipe expands, the slip-ends and backing-rings move toward the middle of the joint and the copper diaphragm, which touches the backing-ring only at the inner edge when the pipe is contracted, is now drawn close over the backing-ring which reinforces it and carries the pressure of the steam.

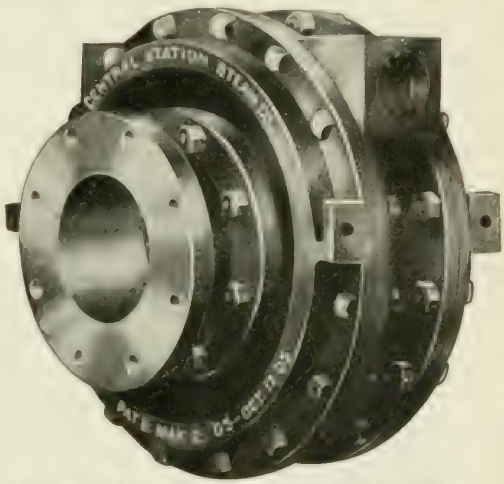


FIG. 2—EXTERIOR VIEW OF NEW TYPE OF DOUBLE EXPANSION JOINT

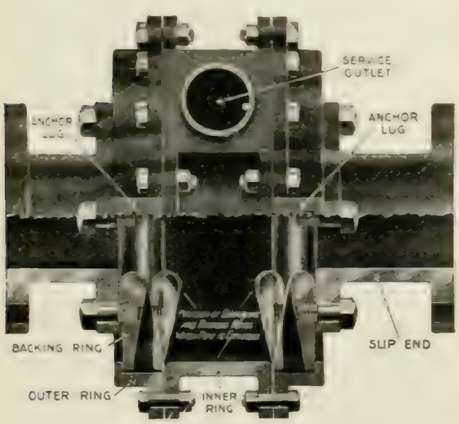


FIG. 1—INTERIOR VIEW, NEW TYPE OF DOUBLE EXPANSION JOINT

But few parts enter into the construction of this device, a double joint capable of taking up the expansion in 100 ft. of line having only nine parts, exclusive of bolts and anchors. The diameter is also small, resulting in a saving in cost of the masonry work around the joint. The diaphragms are smooth, without

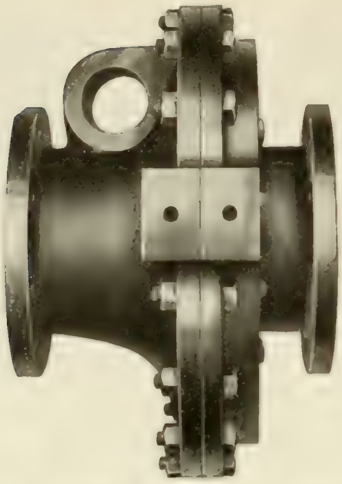


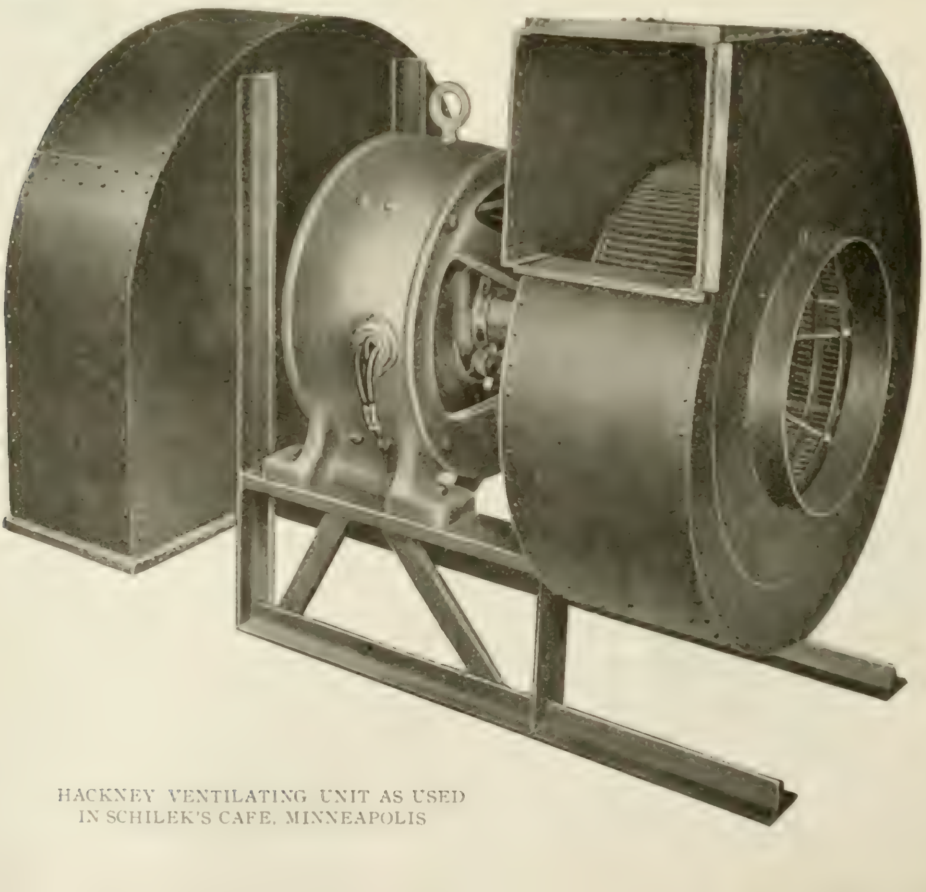
FIG. 3—SINGLE EXPANSION JOINT

corrugations to crystallize and break in service, and changes of position due to expansion bring no tensile strains on the copper. The maximum bending of the copper at any point, due to change of position, cannot exceed 10°.

A large factor of safety has been provided in the length of traverse. The general practice is to provide for ⅞-in. expansion in 50 ft. of line. These joints are designed to permit of 1¼-in. in 50 ft.

The single joint is similar in construction to the double joint except that it has but one diaphragm and is designed to take up the expansion in only 50 ft. of line. The construction is patented.

The Value of Ventilation is discussed in a new circular issued by the Hackney Ventilating Company, St. Paul, Minn., which also contains a description, with photographic illustrations, of the Hackney system of ventilation. This system is based on the principle that ventilation consists in introducing air into a building from out-of-doors, circulating it thoroughly, but without drafts, and finally discharging it again from the building. In order to accomplish this result two blowers are used, one to force the air in and another to draw it out. These two blowers are each designed to handle the same quantity of air. The general arrangement of the system may be noted by referring to the accompanying illustration. The company also manufactures a smaller portable type to be set in the window, simultaneously supplying fresh air and exhausting vitiated air.



HACKNEY VENTILATING UNIT AS USED IN SCHILEK'S CAFE, MINNEAPOLIS

TRADE AND MISCELLANEOUS NOTES

Coming Events

May 29-June 1, 1911. Twenty-third annual convention of the National Association of Master Steam and Hot Water Fitters, at Chicago, Ill. Headquarters at the Hotel Sherman.

May 30-June 2, 1911. Spring meeting of The American Society of Mechanical Engineers at Pittsburg, Pa.

June 6-8, 1911. Third annual convention of the National District Heating Association at Pittsburg, Pa. Headquarters will be at the Fort Pitt Hotel.

June 13-15, 1911. Annual convention of the National Association of Master Plumbers, Galveston, Texas. Headquarters at the Tremont Hotel.

Deaths

James R. Wade, manager of the St. Louis branch of the Consolidated Engineering Co., of Chicago, and late president of the National Vacuum Steam Heating Co., of St. Louis, shot himself in his office in that city, March 10. He died instantly. He was 57 years old. Mr. Wade was a member of The American Society of Heating and Ventilating Engineers. He leaves a widow.

Frederick S. Gillis, a retired member of the firm of Gillis & Geohegan, New York, one of the oldest contracting firms in steam and hot water heating in the country, was killed through the accidental discharge of a revolver which he was in the act of cleaning in his apartments in New York, March 20. He was a son of the late Charles A. Gillis and his interest in the firm of Gillis & Geoghegan was recently purchased by the sons of Stephen J. Geoghegan. He is survived by his wife.

Miscellaneous Notes

Ingenieria, the Spanish trade journal

formerly published by John A. Allen and Elmer T. Crawford, for many years publishers of *Domestic Engineering,* Chicago, has been purchased by The America Co., 1 Madison ave., New York, and will hereafter be published in New York instead of Chicago.

Lewis & Kitchen, Chicago and Kansas City, the well-known heating and ventilating engineers and contractors, announce the addition to their partnership of Samuel R. Lewis, who has been identified with the business for the past fourteen years as consulting engineer. The firm has heretofore been composed of Edward C. Lewis, father of Samuel R. Lewis, and John H. Kitchen, partners. The business will be conducted under the same name with offices in Chicago and Kansas City and factory in Kansas City.

Harry S. Martin has resigned as sales manager of the Hart & Crouse Co., Utica, N. Y.

Plumbing, Steam and Metal Salesmen's Association of Maine held its fifth annual meeting and dinner at the Riverton Park Casino, Portland, Me., March 13. The following officers were elected: President, Stewart Mallard, Henick Co., Boston; first vice-president, George W. Paul, Crane Co., Boston; second vice-president, Byron E. Near, H. W. Johns-Manville Co., Boston; third vice-president, Archibald E. Campbell, Wm. H. Gallison Co., Boston; secretary-treasurer, W. F. Snow, J. L. Mott Iron Works, Boston.

E. N. Hannaford, mechanical engineer for the Cincinnati Board of Education, has resigned to become associated with Peck, Anderson & Peck, Cincinnati, heating and ventilating engineers and contractors.

Charles F. Hauss, sales manager of the Societa Nazionale dei Radiatori, Milan, Italy, the representatives in Italy of the American Radiator Co., has paid a brief visit to the home office in Chicago, returning by the Lusitania March 22.

Richard D. Kimball Co., New York, announces the resignation of S. H. Brooks as manager of its Department of Inspection and Tests. Mr. Brooks has been appointed sales manager for the Monarch Vacuum Cleaner Co., in Indiana, Ohio, and other States, with headquarters in Indianapolis.

R. P. Bolton Co., Liberty Tower, Nassau and Liberty Sts., New York, is the title of a new firm that will engage in "construction engineering." The firm is composed of Reginald Pelham Bolton, president of The American Society of Heating and Ventilating En-

gineers; Frederick A. Forgee, and M. F. Thomas, members of the same society. All three members of the firm are well known to the trade, having long been engaged in mechanical engineering work.

United Bunch of Sheep, Supreme Fold, which is the title of the national organization of this body of salesmen, held its annual meeting in Chicago, March 18. The attendance included sixteen duly elected representatives from the various branch folds and nearly forty additional members. The following officers were elected: Supreme grand ram, T. H. Hutchinson, New York; supreme vice-ram, E. C. Molby, New York; supreme keeper of golden fleece, Henry Stein, New York; supreme shearer, J. W. Gannon, New York; supreme shepherd, F. H. Meadows, Milwaukee; supreme herder, Walter S. Rait, Chicago; supreme bell sheep, A. P. Dease, Chicago; past-grand ram, J. T. Ketchum, Milwaukee.

Baltimore, Md.—The sale of the property and franchises of the Baltimore Refrigerating and Heating Co., which was made on February 1 to the Central Securities Co., at the price of $503,000, has been formally ratified by Judge Stockbridge in Circuit Court No. 2.

Manufacturers' Light & Heat Co., Chicago, announces the election as its president of John E. Gill, of Franklin, succeeding Edward H. Jennings. James I. Buchanan has been elected second vice-president, a newly-created office.

Madison, Wis.—Judge Stevens of the circuit court has decided that the trustees of the Cawker estate in Milwaukee are not under the control of the railroad commission. The plaintiffs own and operate a heating plant in connection with the Cawker building in Milwaukee which furnishes heat, light and power to the building. The plant was installed and maintained by the plaintiffs to meet their own demands, and finding that it created more heat and light than was necessary for their own use they entered into an agreement with three tenants to furnish them with what they would need. The railroad commission held that the Cawker plant is a public utility. The court says: "There is nothing in the legislative intent as expressed in the law or in the facts pleaded with relation to plaintiff's plant that would warrant the court in holding that the three persons or corporations to whom light, heat and power are furnished by the plaintiff constitute the public, within the meaning of the statutes."

Pittsburg, Kan.—A committee of the local board of education, appointed to inquire into the various systems of heating in Kansas City and Topeka, has made a report of its findings in which it states that after seeing plants in operation both in school houses that have been built six or eight years and in new buildings in both cities, it recommends the furnace blast system, with automatic regulation, for the heating of school houses, which was the predominant type found by the committee in both Topeka and Kansas City.

Eastern Illinois Heating League is an organization formed March 28 last at Champaign, Ill., composed of heating contractors and engineers from nine cities and towns of Eastern Illinois. The league is organized to promote both the commercial and technical features of the business as well as to take up the matter of the relations of employers and employees. The following officers were elected: President, E. J. Ryan, Danville; vice-president, Dick Johnson, Champaign; secretary-treasurer, Fred White, of White & Hanson, Mattoon. The charter members of the new organization are: O. W. Sebring, Cissna Park; A. W. Murray, Hoopeston; L. W. Straw, Carson & Co., Carson-Payson Co., W. S. Hannum, King Bros., F. A. Mahoney, M. L. Meeker, E. J. Ryan, Uhlein & Burrow, all of Danville; Webster & Holmes, Urbana; Johnson Bros., Reliable Plumbing & Heating Co., E. A. Robinson, W. R. Woezeneraft, R. L. Young, Carson-Payson, all of Champaign; Henry L. Williams, Farmer City; White Plumbing & Heating Co., Charleston; White & Hanson, Mattoon, and Gill R. Capen, Mattoon.

Manufacturers' Notes

Crane Co., Chicago, has begun the erection of a branch supply house at Ogden, Utah.

McNab & Harlin Mfg. Co., 56 John St., New York, manufacturers and dealers in heating and plumbing supplies, will move to larger quarters directly opposite its present location, which it has occupied for upwards of twenty-five years.

John T. Young Boiler Co., Norwich, Conn., will double the capacity of its plant by building a machine shop 100x50 feet. A new 30x30 ft. office building will also be constructed

Niagara Radiator & Boiler Works, North Tonawanda, N. Y., is adding eight new buildings to its plant at a cost of $100,000, which will double its present capacity. J. C. Andrews is president and general manager

Shirley Radiator & Foundry Co., Shirley, Ind., announces the appointment as general manager of the company of Charles E. Gates, for many years general manager of the plant of the McElwaine-Richards Co., at Noblesville, Ind. The plant is being greatly enlarged by the receivers, the Union Trust Co., of Indianapolis. Late additions to the company's line are a standard pool

38-in. 5-ft. radiator, both plain and ornamental, and an 18-in. round boiler for both water and steam.

Novelty Iron Co., Canton, O., manufacturers of heating boilers, announces the following changes in its officers, which has led to the report that the company has been purchased by Eastern capitalists at a sum stated to be in the neighborhood of $300,000. The new officers are: President, Huntlie Gordon, Boston; vice-president and general sales manager, George E. Downe; secretary and treasurer, H. H. Bryan, Johnstown, Pa., succeeding W. E. Sherlock. It is stated that the changes will not affect the operation of the plant.

Reading Stove Works, Orr, Painter & Co., Reading, Pa., announces that it will discontinue the manufacture of its line of steam and hot water heating apparatus, although repairs for these goods will be kept in stock.

Pierce, Butler & Pierce Mfg. Co., Syracuse, N. Y., has opened a new branch in Cleveland, consisting of office, showrooms and warehouse. J. H. Bacon, Jr., is in charge.

New Work

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, until May 9, 1911, for the construction complete, including plumbing gas piping, heating apparatus, electric conduits and wiring of the U. S. Post Office at Faribault, Minn.

Minneapolis, Minn.—The city hall and courthouse will be equipped with a new ventilating system by the adoption of tentative plans by the city and county building commission. The action followed the reading of the recent grand jury report which sharply criticised the management of the building in recent years. Chief Engineer George Hull declared that the cold air ducts are twice too large and that the principal portion of the system had been shut off because of the dirt it carried into the rooms.

Oklahoma City.—Among the bills passed in the final hours of the legislature March 12, was one appropriating $16,400 for a heating plant at the Claremore preparatory school.

Fort Wayne, Ind.—Owners of the fifty-six lots bordering on Forest park boulevard in the new Forest park addition have taken up the problem of installing a central hot-water heating plant to heat all the homes on the boulevard.

Business Changes

National Plumbing & Heating Supply Co., Chicago, has increased its capital stock from $25,000 to $75,000.

New Incorporations

Quadruple Steam Pump Co., Jersey City, capital $25,000, to engage as tool makers, metal workers, boiler makers, etc. Incorporators: Arthur McNeil, John W. Derbyshire and Frank E. Collier.

E. Best Plumbing & Heating Co., Quincy, Ill., capital $30,000, to engage in heating, plumbing, electrical and gas fitting contracting business. Incorporators: Ezra Best, Seward Best and T. Russell Bunting.

Slater Weather Strip Co., Buffalo, N. Y., to manufacture metal weather strip. Incorporators: J. J. Slater, H. I. Slater and D. J. Ward, all of Buffalo.

Smith Bros. Plumbing Co., Inwood, N. Y., capital $50,000. Incorporators: Charles Smith, J. Ezra Smith and George W. Foren.

Bishop-Babcock-Becker Co., Cleveland, O., is the new title of the Bishop & Babcock Co., manufacturers of vacuum heating appliances, also soda water fountains and beer pumps, as the result of the absorption of the Becker Company, of Chicago. The company's capital stock has been increased from $4,500,000 to $8,500,000. The new officers are: President, K. D. Bishop, who was president of the Bishop & Babcock Co.; vice-president, L. A. Becker, formerly president of the Becker Co. In addition to building additions to its plants in Cleveland and Indianapolis, the company will erect a new plant at Dallas, Texas.

Canton Heating & Foundry Co., Canton, Ill., has been organized to succeed the Savill-Chandler Co., of that place and will manufacture heating boilers, radiators and valves and do general foundry work.

Evansville Plumbing Co., Evansville, Ind., capital $10,000, to conduct a general heating and plumbing business. Incorporators: Emil H. Hartig, Anna Hartig and C. F. Werner.

Selman Heating & Plumbing Co., Birmingham, Ala., capital $15,000, to conduct a heating, ventilating and plumbing business.

Ellis Radiator Co., San Francisco, Cal., capital $50,000. Incorporators: M. S. C. Ellis, J. W. Stearns, W. J. Clarke, E. H. Hechman, W. A. Moffett, T. F. Draper and E. Marmet.

D. and T. Mfg. Co., St. Louis, Mo., to manufacture and deal in heating apparatus. Capital, $30,000, three-fourths paid. Among the stockholders are John M. Dougherty, Harry C. Tabler, George E. Miller, James W. Gill, John P. Assmann, Joseph Barrett, Henry Heimberg and Edward J. McMullen.

Koblitz Plumbing & Heating Co., Cleveland, O., capital $25,000. Incorporators: O. E. Koblitz, D. N. Tilden, and N. I. Young.

Contracts Awarded

H. T. Wheelock, Burlington, Vt., heating, ventilating and plumbing new Lamoille County courthouse, jail and sheriff's residence for [illegible]

Wanner Steam and Hot Water Heating Co., Baltimore, Md., water pipe and steam heating for sewerage station in that city. The contract amounts to $1,100.

H. Kelley & Co., Minneapolis, Minn., heating and ventilating the new high

school building at Albert Lea, Minn., for $18,500. The plumbing contract went to the Fort Dodge Heating and Plumbing Co., Fort Dodge, Ia., for $7,421.26.

Lane & McNally, Hannibal, Mo., heating Souch school annex at that place for $2,777.18.

Allen, Myers & Co., Rock Island, Ill., heating new Rock Island Savings Bank building in that city.

American Heating Co., Duluth, Minn., heating system for remodeled Metropolitan building in Duluth.

Healy Plumbing and Heating Co., St. Paul, Minn., heating and plumbing for the laundry building at the city hospital for $6,195.

Buffalo Forge Co., Buffalo, N. Y., contract for ventilating systems in the Anchor Line boats "Juniata" and "Octorara," for the Erie and Western Transportation Company of Buffalo. The company had already installed similar system in the steamer "Tionesta" of the same line. This system was for the inside staterooms. Its successful operation led to the subsequent order. The Buffalo Forge Company also reports an order received from the New Jersey Zinc Company for 54 large special fans. It is estimated the fans will make up over eight carloads. The order, the company states, was placed after a number of different manufacturers had been given an opportunity to install an experimental blower to be tested for efficiency under special but identical conditions. The contract was awarded to the Buffalo fan in accordance with the showing made.

Evans Plumbing Company, Niles, Mich., heating, ventilating and plumbing new central school building, in that place, for $20,000. Garden City Fan Company's apparatus will be used. The latter company's plant is located at that point.

Modern Science Club, Brooklyn, N. Y., was addressed March 14 by James A. Donnelly, on "Standard Devices for Exhaust Steam Heating," illustrated by stereopticon.

Brooklyn Engineers' Club, Brooklyn, N. Y., held a "ventilation meeting" March 9, when W. W. Macon read a paper on "Late Ideas on Ventilation," in which he discussed the new theories on this subject which have recently been advanced.

Trade Literature

Tachometers and Tachographs, stroke and revolution counters, of Dr. Th. Horn, Leipzig, Germany, are made the subject of a special bulletin (No. 40), by the Industrial Instrument Co., Foxboro, Mass., exclusive agent for the United

States. All speed measuring instruments are listed from simple speed indicator to counter revolution to the elaborate precision variation recorder. The catalogue is fully illustrated. Pp. 36. Size 8x11 in.

Bruce-Macbeth Vertical Multi-Cylinder Gas Engines, for electric lighting, pumping and all general power purposes, using either artificial, natural or producer gas, or gasoline, are described in a newly-issued catalogue devoted to the product of the Bruce-Macbeth Engine Co., Cleveland, O. The various features of this type of engine are covered in detail, with exterior and interior views of different parts of the mechanism, accompanied with view of typical installations. Pp. 32. Size 7x10 in.

Some of the Factors that Affect the Cost of Generating and Distributing Steam for Heating, a paper by Charles R. Bishop, read at the last annual convention of the National District Heating Engineers in Toledo, has been reprinted by the American District Steam Co., North Tonawanda, N. Y., as Bulletin No. 120. We understand that copies may be had for the asking by addressing the company.

Ventilation in Its Relation to Health, a paper read by William G. Snow at Cornell Unversity in the course on "Sanitary Science and Public Health," in cooperation with the New York State Department of Health, and published in part in THE HEATING AND VENTILATING MAGAZINE for August and September, 1910, has been printed in full by Warren Webster & Co., Camden, N. J., from whom copies may be obtained without charge

Bicalky Roof Fan Ventilator is the subject of a new booklet published by the Bicalky Fan Co., Buffalo, N. Y., showing a number of typical installations of this ventilator taken from photographs. These include roof views of the Hotel Statler in Buffalo, which is equipped with Bicalky devices; also interior views of a smelting plant before and after the Bicalky ventilators were installed. The company announces that the other specialties it manufactures include Bicalky dust arresters and Bicalky air washing and humidifying apparatus.

Steam Specialties manufactured by W. A. Russell & Co., 63 West 37th street, New York, are described in a newly-issued catalogue, covering the company's line of automatic air valves, positive key and wood wheel air valves, floor and ceiling plates. The Russell air valves have been manufactured by this company for 20 years and these devices, together with its line of floor and ceiling plates, enjoy a wide and deserved reputation. Pp. 69. Size 3½x6 in. (standard).

Armak Steam Vacuum Heating System is the subject of Bulletin No. 2, published by Arthur McGonagle, 136 Liberty street, New York. Special attention is called to the fact that in offering this system for sale, no charge is made for royalty. While doing no erecting the company states that it will be glad to furnish plans for complete installations. In addition to a full description of the system, and of the devices used in connection therewith, the bulletin shows typical layouts properly designed for operation with the Armak devices. Pp. 14. Size [illegible] in. (standard).

What Boiler Ratings Mean to You, published by the Richardson & Boynton Co., New York, presents a comparison of Richardson boiler ratings as they are and as they would be at higher rates of combustion. The tables presented show the original and present ratings and list prices of Richardson boilers, together with the ratings as they would be burning coal at [illegible] and [illegible] lbs. per square foot of grate per hour. The company states that these tables make possible a comprehensve comparison of the ratings and prices of Richardson boilers with those of any other manufacturer. Examples are included showing how to make use of the tables. Pp. 16. Size [illegible] in.

THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK MAY, 1911

A House with Radiators on Inside Walls

A scheme for placing the radiators in a building on the inside walls, with resultant saving in the amount of piping needed, was described at the recent meeting of the Heating Engineers' Society by F. K. Davis, of Baltimore. According to tests of the system made by Mr. Davis, the rooms were not only comfortably heated, without undue window drafts, but, in a similar case, radiation so located showed a considerably higher efficiency than that ordinarily obtained when placed near outside windows.

The general layout of the system is shown in Fig. 1. This house, said Mr. Davis, is fairly typical and is of the ordinary frame construction, having been built about ten or twelve years ago. The ceilings of the basement are not plastered, but the boiler and piping is covered and the windows are tight.

"You will note," continued Mr. Davis, "that there is very little outside wall space that is not taken up by windows. The window sills are about 10 in. above the floor, the tops running to within 8 in. of the ceiling. There was so little wall space in the room for radiation that, as a final solution, we put it at the points indicated in Fig. 1.

"This installation has gone through two winters in which the lowest temperature, I think, has been in one case 8° F. below zero, and in the other 3° F. below zero. The owner of the house tells me that never on any occasion has it been necessary to exceed a water temperature in his boiler of 145° F. to heat his house comfortably, which means usually in excess of 70° F.

"The proportion of heating surface in this house, assuming 4 sq. ft. of wall to be equal to 1 sq. ft. of glass surface, is a little less than 1 sq. ft. of radiation to each 2 sq. ft. of glass. When I first mentioned this installation, immediately the question was raised that there were cold drafts across the floor and that this in itself would condemn the method. One day I visited the house, taking with me an anemometer calibrated flat to 200 and very sensitive. I experimented with the anemometer on the floor to see if there was a perceptible draft across the floor. In no case could I get draft enough to start the wheel of the anemometer with the gear out. Thermometers hung from the chandelier, one at the breathing line and one about 4 to 6 in. above the floor, showed a differential of less than 2° F., indicating that there was not any perceptible cold draft across the floor. The outside temperature was about 30° F. and the wind velocity about 12 miles an hour, from the northwest. There was no test made of the temperature directly in front of the windows, nor were there any measurements made

of the air going up through the fireplaces. I presume there were currents of air there.

HIGHER EFFICIENCIES OF RADIATORS ON INSIDE WALLS

"In this same general connection, I happened to be taking part in some tests in Baltimore on ten houses which were identical. In some of the houses the radiation was placed a little bit different from that in the others. I spent practically two weeks in those houses at work on a theory that there seemed to be an error in the so-called coefficient for the transmission of heat from radiators. We base our coefficients usually at 1.7 B. T. U. per degree difference.

"Now, I have never been able to find the air in contact with the radiator as low as 70° F. The lowest temperature I ever got was 84° F. That was on a radiator where the boiler temperature was about 135° or 140° F. The air in contact with the radiator has varied from 84° F. to as high as 120° F. on a steam radiator where the temperature of the steam was 215° F."

Mr. Cesar Teran: "I would like to know the method that was used to obtain the temperature of the air in contact with the radiators."

Mr. Davis: "Thermometers were hung at the points shown in Fig 2, so that the approximate clearance between the iron and the thermometer was from ¼ in. to ⅛ in. Then we kept on right out at right-angles ½ in. apart till we got further out, where the thermometers were probably spaced 1 in. apart. We used six or eight thermometers in the same line.

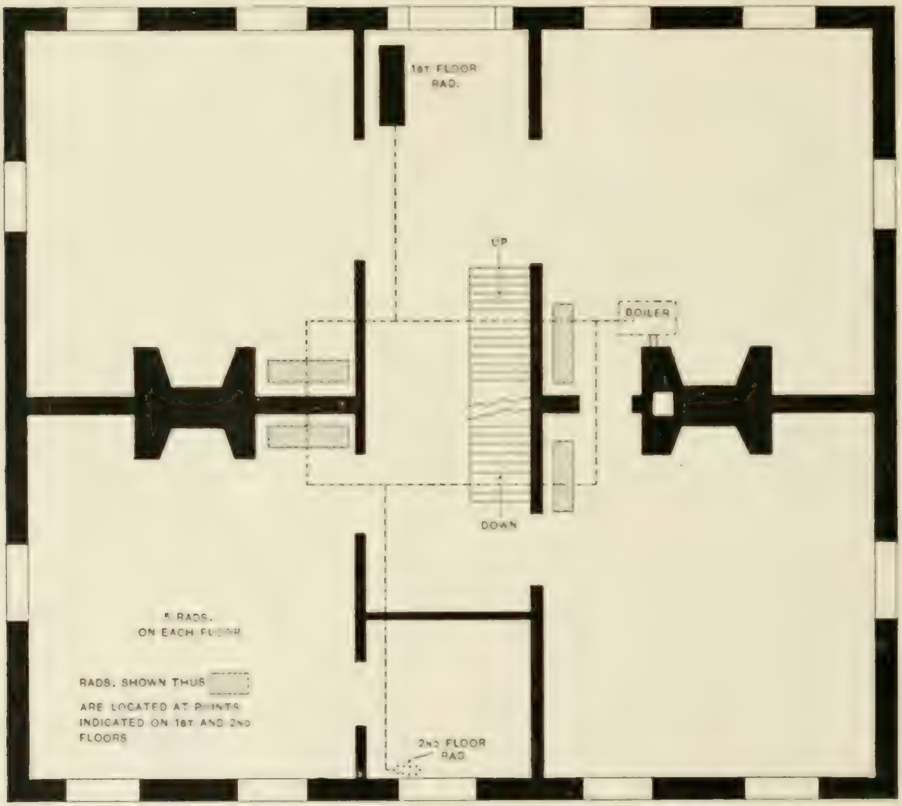


FIG. 1—ARRANGEMENT OF HEATING SYSTEM IN HOUSE WITH RADIATORS ON INSIDE WALLS

"The general belief is that a thermometer placed near a heated sur-

face is affected by radiant heat, but I found in every case where I put a paper tube around the bulb of the nearest thermometer, the temperature would immediately rise, showing that there was more refraction than absorption of the heat by the bulb of the thermometer.

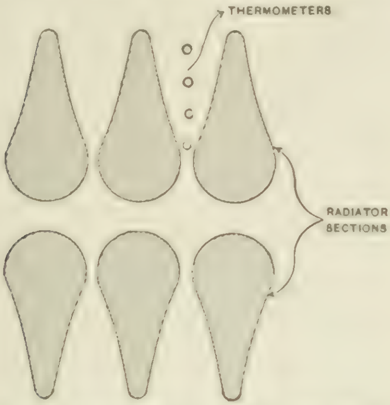


FIG. 2—ARRANGEMENT OF THERMOMETERS FOR DETERMINING TEMPERATURE OF AIR IN CONTACT WITH RADIATOR

"The high temperature I observed in the air next to the radiator indicated to me that there is something wrong with the accepted coefficient. Some of the radiators in the building in question were on the outside walls, some at right-angles to cold walls and a few of them placed under the windows. I found uniformly that the radiators under the windows gave a higher temperature of air in contact with the radiator. Those on the cold walls would most nearly approach them. Those that were placed at right-angles to the cold walls seemed to prove the matter, from the fact that the different sections would be higher in temperature nearer the cold wall. As we got away from the cold wall the temperature of the air would drop, until when 2 or 3 ft. away from the cold wall we got the same result that we would get on the radiator placed entirely on the warm wall.

Now, the proportion of heat transmitted by a radiator is proportional to the temperature of the cooling medium or air in contact with the radiator; so that it seems to show conclusively that the radiator on the warm wall is more efficient and transmits more heat than the radiator placed on the cold wall or under a window."

Use of Cold Air in Ventilating Systems

That it is not only possible, but preferable and economical, to admit fresh air into a room without warming, is a proposition recently advanced by the Hackney Ventilating Co., of St. Paul, Minn., which will be gone into at length in a new booklet on the subject, shortly to be issued. To admit such cold air for ventilating purposes the writer will say that it is necessary to locate the inlets 8 ft. or more from the floor and have them of such size and number that only a comparatively small quantity of air will be admitted at each inlet, this quantity being dependent upon the height, not only of the inlet, but of the ceiling.

To illustrate: If inlets be located on or near a 10-ft. ceiling, they should each be limited to about 4,000 cu. ft. of air per hour, while, if the height be increased to 16 ft. the air capacity of each inlet may safely be doubled. Where ceilings are abnormally high, the air may be carried up 20 to 25 ft. and inlets provided with a capacity of 20,000 cu. ft. per hour, with no danger of drafts.

"Now, let us consider carefully," continues the writer, "the result of admitting air into a room without warming. It is a matter of common knowledge that the temperature at the ceiling is always higher than at the floor. Admitting cool air well up from the breathing line, it immediately assumes a downward course, due to gravity, and, as it descends, is thoroughly warmed by the ascending

movement of heated air from radiators, stoves or hot-air registers. The law of diffusion causes both the cool and warm air to spread, while on their downward and upward courses, respectively, with the result that, instead of forming an objectionable down draft, as might be expected, the air assumes a comfortable temperature by the time it reaches the breathing line.

"This method produces a quality of ventilation that is extremely refreshing and can only be appreciated by those who have enjoyed its benefits. The laws of diffusion and gravity are coöperated with, rather than ignored, and the air is not expected to form in currents and travel about the room, according to the desires of the designer.

"This mixing of cool and warm air gives a circulation that is impossible when the air is admitted warm. Not only does this method afford better ventilation, but it offers a number of economic advantages. In the original cost there is a great saving in omitting master coils, and in the maintenance, another saving is effected by eliminating entirely the loss of heat while the air is in transmission from the coils to the inlets and also by using the heat at the upper part of the room for warming the incoming air.

LOCATION OF FOUL AIR OUTLETS

"The proper location of the foul air outlets has been discussed extensively. The writer believes the matter can be settled for all practical purposes by saying that in a room where there is no circulation of air the impurities will settle to the floor, about 85% being found in the lower half of the room, and the remaining 15% in the upper half. However, it does not follow that to remove these impurities it is necessary to locate the outlets near the floor. If the air be put in circulation the impurities will be found at the ceiling as well as at the floor. In fact, they will be pretty generally distributed in all parts of the room, and it will matter but very little where the outlets are located. Where the air is admitted into the room cold the outlets may be located at the ceiling without fear of wasting much heat, and in cases where smoke, light gases, odors or excessive heat are to be removed, the ceiling is the only logical location for the outlets. It is sometimes advisable to have outlets both at the ceiling and the floor, and to have them adjustable, so that either may be used, or both, as occasion demands.

"The fact should be emphasized that ventilation is a process of dilution. Fresh air does not come in and displace foul air, but mixes with it, and it is this mixture which is drawn out. It is not necessary to provide as many outlets as inlets, as a considerably quantity of air may pass out through one opening without causing a perceptible draft.

"Where cold air is furnished for ventilating purposes, the location of the blowers should be in the attic or in a pent-house on the roof. This location offers several advantages. In the first place, the operation of the plant will be in harmony with nature's laws, as the colder air will flow downward and the warmer air upward. By this method the expense of air stacks may be saved, as the blowers will be within a few feet of the outside air. Space is used which is of no value for any other purpose, and a further saving can generally be effected by carrying the main supply lines through the attic rather than in the basement."

No heating system can possibly succeed that maintains an even temperature. I know how that hits many accepted theories. We are changeable creatures and we need the stimulus of cold air occasionally. To keep fresh the air about the body and clothing is as important as to keep pure the air that enters the room. So there is no best temperature. We all need a change of temperature.—*Dr. Luther H. Gulick before the Heating Engineers' Society.*

Factory Sanitation and Efficiency

By C. E. A. Winslow

An appeal for good air, of proper temperature and humidity, in factories, when based on economic grounds, is undoubtedly the most effective means of securing favorable action on the part of the owners. Such an appeal is made in a paper read before the recent Congress of Technology in Boston, by Professor C. E. A. Winslow, associate professor of biology in the College of the City of New York and curator of public health, American Museum of Natural History, New York.

Professor Winslow pointed out in the beginning of his paper the fact that humidity and temperature conditions in factories, though they profoundly affect the efficiency of the workmen, have received very little attention from the manufacturer himself, and this little almost wholly under the compulsion of State laws. "For the moment," said Professor Winslow, "I am quite frankly and coldly treating the operative as a factor in production whose efficiency should be raised to the highest pitch, for his own sake, for that of his employer and for the welfare of the community at large.

"The intimate relation between the conditions which surround the living machine and its efficiency is matter of common experience with us all. Contrast your feelings and your effectiveness on a close, hot, muggy day in August and on a cool, brisk, bright October morning. Many a factory operative is kept at the August level by an August atmosphere all through the winter months. He works listlessly, he half accomplishes his task, he breaks and wastes the property and the material entrusted to his care. If he works by the day the loss to the employer is direct; if he works by the piece the burden of interest on extra machinery has just as truly to be borne. At the close of the day the operative passes from an overcrowded, overheated workroom into the chill night air. His vitality lowered by the atmosphere in which he has lived, he falls a prey to minor illness, cold and grip, and the disturbing effect of absences is added to inefficiency. Back of it all lurks tuberculosis, the great social and industrial disease which lays its heavy death tax upon the whole community after the industry has borne its more direct penalty of subnormal vitality and actual illness.

"The remedy for all this is not simply ventilation in the ordinary sense in which we have come to understand the term. Conditioning of the air so that the human machine may work under the most favorable conditions,—this is one of the chief elements of industrial efficiency as it is of individual health and happiness.

"The chief factors in air conditioning for the living machine, the factors which in most cases far outweigh all others put together, are the temperature and humidity of the air. Heat, and particularly heat combined with excessive humidity, is the one condition in air that has been proved beyond a doubt to be universally a cause of discomfort, inefficiency and disease. Flugge and his pupils in Germany and Haldane in England have shown that when the temperature rises to 80° F. with moderate humidity, or much above 70° F. with high humidity, depression, headache, dizziness and other symptoms associated with badly ventilated rooms begin to manifest themselves. At 78° F., with saturated air, Haldane found that the temperature of the body itself began to rise. The wonderful heat regulating mechanism which enables us to adjust ourselves to our environment had broken down and an actual state of fever had set in. Overheating and excess of moisture is the very worst condition existing in the atmosphere, and the very commonest.

"The importance of the chemical impurities in the air has dwindled rapidly with the investigations of recent years. It was long believed that the carbon dioxide was an index of some subtle and mysterious 'crowd poison' or 'morbific matter.' All attempts to prove the existence of such poisons have incontinently failed. Careful laboratory experiments have quite failed to demonstrate any unfavorable effects from rebreathed air if the surrounding temperature is kept at a proper level. In exhaustive experiment by Benedict and Milner (Bulletin 136, Office of Experiment Station, U. S. Department of Agriculture), seventeen different subjects were kept for periods varying from three hours to thirteen days in a small chamber with a capacity of 197.6 cu. ft. in which the air was changed only slowly while the temperature was kept down from outside. The amount of carbon dioxide was usually over 35 parts (or eight to nine times the normal), and during the day when the subject was active it was over 100 parts, and at one time it reached 231 parts. Yet there was no perceptible injurious effect.

"The main point in air conditions is, then, the maintenance of a low temperature and of a humidity not too excessive. For maximum efficiency the temperature should never pass 70° F. and the humidity should never be above 70 per cent. of saturation. At the same time, a too low humidity should also be avoided. We have little exact information upon this point, but it is a matter of common knowledge with many persons that very dry air, especially at 70° F. or over, is excessively stimulating and produces nervousness and discomfort. It would probably be desirable to keep the relative humidity between 60 and 70 per cent.

"Another point which may be emphasized in the light of current opinion is the importance of 'perflation,' or the flushing-out of a room at intervals, with vigorous drafts of fresh, cool air. Where there are no air currents the hot, moist, vitiated air from the body clings round us like an 'aerial blanket,' as Professor Sedgwick calls it, and each of us is surrounded by a zone of concentrated discomfort. The delightful sensation of walking or riding against the wind is largely due, perhaps, to the dispersion of this foul envelope, and it is important that a fresh blast of air should sometimes blow over the body in order to produce a similar effect. The same process will scatter the odors which have been noted as unpleasant and to some persons potentially injurious. The principal value of the carbon-dioxide test to-day lies in the fact that under ordinary conditions high carbon dioxide indicates that there are no air currents changing the atmosphere about the bodies of the occupants.

"There is plenty of evidence, though, of a scattered and ill-digested sort, that the elimination of such conditions as these brings a direct return in increased efficiency of production."

Oxygen is not nearly so important as has been generally supposed. There is an apparatus in the back part of the human brain which controls respiration, so that within such a variation of oxygen as occurs, even in the worst-ventilated room, the amount of oxygen used by the individual does not vary at all, so far as is shown by the most accurate experiments it has been possible to make. If there is 18 per cent. of oxygen in the air, you extract from it just as much as if there were 21 per cent., which is the normal amount. If, by artificial means, the amount of oxygen is made to fall below 15 per cent., this regulating apparatus which makes you breathe faster when there is less oxygen in the air is not adequate to overcome the obstacle.—*Dr. Luther H. Gulick before the Heating Engineers' Society.*

Air Conditioning in Industrial Work

I.—REGULATION OF HUMIDITY IN PAPER MILLS

By Alexander H. Twombly

Editor's Note.—The necessity for controlling the humidity in connection with certain classes of manufacturing has opened up a field of engineering with which heating and ventilating engineers may well become more familiar. The present article, which appeared in Paper, is the first of a series we will publish which will discuss the peculiar conditions to be found in each industry, and practical measures that may be taken to meet such conditions.

The machine-rooms of a paper mill require special and scientific methods of ventilation owing to the large amount of moisture given off by the drying paper. This moisture amounts to about 150% of the weight of the dry paper, as the sheet of paper leaving the presses and going to the dryers contains about 60% water. That is, if the paper machine produces 24 tons of paper in 24 hours, the amount of moisture driven off into the air from the dryers will be about 36 tons during the 24 hours.

When not properly cared for this moisture will result in a foggy, moist room with a continual dropping of moisture due to condensation on the roof, pipes and walls, which will spot the paper, and the temperature and humidity of the air will make the room most uncomfortable for the operatives. If colder air from the outside obtains entrance through cracks, windows or doors, the drop in temperature will cause the interior of the room to be filled with fog and rain.

It is not unusual to find the paper machines entirely hooded to keep the moisture from spreading into the room, and a large exhaust fan operating at the top of the hood to carry away the vapor from the dryers. The hood interferes, however, with the operation of the machine, the light, the removal of broken paper, the replacing of dryer felts, and the handling of repair parts, and collects dirt. This is especially true when the quality of the paper is such that frequent breaks occur upon the dryers, and when the machine operates at a high speed.

Disc fans for ventilating are frequently placed in the roof or in dormer windows to carry away the moist air. These fans are not positive enough in their action, taking the air which comes to them only, and not creating a definite current. Unless warm air is made to flow over the machine directly to these fans they do not successfully accomplish the necessary ventilation. A strong wind against a disc fan almost entirely prevents its action. If warm air from an outside source is not supplied in sufficient quantity to the machine-room, the sudden opening of a door will cause an enormous temporary draft from the outside, which in cold weather will make a cloud of vapor and fog inside the room.

Another method of ventilation of machine-rooms frequently found is the installation upon the roof over the dryers of a number of ventilators acting by gravity. Their operation, however, depends so much upon atmospheric conditions that their action cannot be depended upon, for it is absolutely essential that a constant supply of warm air should be furnished and removed from the machine. In large mills this air supply is often drawn from other parts of the mill through open doors, but such means are not constant enough under all weather conditions to be satisfactory.

CONSTANT SUPPLY OF AIR REQUIRED

Proper ventilation can only be accomplished by removing the moisture through a constant supply of air which forms a carrier for the moisture from the paper on the dryers, regularly furnished and re-

moved by mechanical means. The capacity of the air to act as a carrier should be as carefully determined as that of a chip conveyor or water supply pipe.

The conditions in each case admit of exact figuring, for there is a definite amount of water contained in the air when saturated for each degree of temperature, and the amount of moisture increases as the air temperature increases. A cubic foot of air, when saturated, contains about fourteen times as much moisture at 170° F. as at 70° F. But a cubic foot of air, when saturated, if heated from 70° to 170°, on account of its increased volume and temperature, will contain, if saturated, about twenty-seven times its initial moisture. The quantity of air which must be supplied, its temperature, the heating surfaces required to produce the necessary temperature, and the velocity of the air about the dryers, and its method of admittance and removal, are all subject to exact mathematical determination.

DRYERS USED AS HEATING SURFACE

The important part which the surfaces of the dryers, uncovered by the sheet of paper, play in the problem of drying is seldom recognized. A careful study of general conditions indicates that at least one-fifth to one-fourth of the dryer surface should be used in heating the air which carries away the moisture from the dryers, and that the remaining dryer surface should be utilized for the direct vaporization of the moisture in the sheet of paper. The uncovered ends of the dryer cylinders form important air heating surfaces. It is essential that a sufficient supply of air to carry away all the water evaporated, without approaching the saturation point, should be supplied and that the temperature of this air when laden with moisture should not be allowed to cool so as to become saturated before its removal, for in that case a fog and rain immediately result inside the machine-room.

DESIRABLE CONDITIONS IN MACHINE-ROOMS

The following will show conditions desired in the machine-room:

The machine should be unobstructed by hoods or coverings which interfere with the operation or the removal of broken paper, or the renewal of dryer felts or repair parts.

The air in which the operatives work in the machine-room should be at a temperature not exceeding 80°, and without undue humidity.

The moisture from the drying paper should be removed without condensation or dripping, and the roof, walls and pipes are to be free from condensation. This condition is to be maintained independently of outside weather conditions.

To obtain these results the roof conditions above the machine are important: There should be as few obstructions from beams or trusses as possible and there should be no pockets. The roof, on account of its large exposed surface, plays a very important part in the precipitation of moisture. It acts as a cooler, and when the moisture laden air at a higher temperature is allowed to come in contact with it, condensation ensues.

The condensation soon rots the roof, and its dripping is a great source of injury to the paper and annoyance to the men. To overcome this difficulty of condensation, it has been customary to place the outlets of exhaust fans or hoods at some distance below the level of the roof in order to draw out the moisture laden air before it reaches the roof, and to try to prevent condensation on the roof by heating the layer of air between the exhaust outlet and the roof with steam circulation coils.

This method has proved inefficient, as the dead air above the circulation coils soon becomes saturated with moisture, which is deposited upon the beams and roof. The steam circulation pipes are also a constant source of annoyance

through leaks and collection of dirt. The roof area is usually large in proportion to that of the walls, and the radiation from the roof is, therefore, the main factor in condensation troubles.

HEATED AIR JETS FOR PREVENTING CONDENSATION AT ROOF

To prevent this condensation, and to preserve the roof, the proper method is to keep the air between the outlets of the exhaust fans and the roof at a high temperature and in constant motion, carrying off with it any moisture which may have a tendency to be deposited upon the roof. This is accomplished by heated air jets wiping across the surface of the roof at a high velocity and entirely preventing condensation. In this way it is possible to keep the roof in a perfectly dry condition, and to prevent any moisture laden air which may pass upward, and by the exhaust outlets, from coming in contact with the roof. The air jets at the same time keep the air free from dust coming from the surface of the paper, and prevent deposits of dirt upon the beams. The circulation pipes, almost universally used and a constant source of trouble, are entirely eliminated; there is no longer need of umbrella hoods over the machines, and the machine is well lighted and free for inspection.

The air supply for a machine-room should be drawn from an outside source through a heating coil by a steel plate fan. The coils should be arranged in sections controlled by independent valves so that the temperature of the air can be properly regulated to produce a temperature in the machine-room of about 80° F. Sufficient air should be delivered at many points well distributed in the machine-room, by the fan to maintain a slightly greater pressure in the machine-room than that of the outside atmosphere, so that cold air from the outside is prevented from entering and all leakage of air through doors, windows and walls is outward.

Above the machine at the front and back of the dryers should be a series of fan-shaped exhaust outlets connected with a positive steel plate exhaust fan. By a proper distribution of these outlets it is possible to obtain the flow of the requisite volume of air at all points of the dryers, in proportion to the amount of vapor given off. This is impossible with a disc fan, or with a hood, and with one or two outlets only. These outlets are the only direct outlets for the air in the machine-room, so that all currents of air converge toward the dryers and pass between and by them to the exhaust outlets.

The volume of air admitted to the room, the points of admission, the direction of its flow toward and over the dryers and its upward movements, are matters which require careful and expert consideration. The volume must be sufficient to carry away the moisture from the room under all outside atmospheric conditions. The percentage of relative humidity in the outside air varies so largely that it is necessary to provide a sufficient volume of air to remove the moisture from the room under extreme conditions of humidity in the outside air and without allowing the inside air to reach a point near full saturation. Unless these conditions are carefully considered the results would be, that, while under certain conditions of the outside air a plant might produce ideal conditions in the machine-room, under other outside air conditions it would prove at least a partial failure.

The air passing from the inlet fan toward the dryers is relatively free from humidity and enables the operatives to work in comfort. After reaching the dryers the faces and ends of the dryers uncovered by the sheet of paper heat the air to a high temperature and increase very greatly its moisture carrying capacity. The wiping action of a strong current of heated air removes many times as much moisture as still air

at the same temperature. The vapor given off from the drying paper unites with the air and is carried above the machine and out of the exhaust outlets by the current produced by the inlet fan and exhaust fan, augmented by its own tendency to rise on account of its high temperature. No opportunity is given for the moisture to scatter about the room, and as the temperature is kept above that of saturation no deposit of moisture is possible.

To summarize: Warm air is forced into the machine-room under a slight pressure, preventing all inward leaks of outside air. The air is carried in a constant stream toward and over the dryers, becoming highly heated, and carrying with it the moisture evaporated from the paper to the exhaust outlets above the dryers and immediately removed. Hot air jets along the roof prevent any condensation or dripping. Under these conditions the machine can be operated to its full and most economical drying capacity.

Actual results indicate that each pound of water evaporated from the paper, when the temperature of the paper stock running on the machine is from 40° to 60° F., requires about 1.5 lbs. of steam for heating the dryers and the air. This corresponds to about 2.25 lbs. of steam for each pound of dry paper. Improvements in conditions will do much to prevent the frequent shifting of paper-machine employees, who often work under very trying conditions, which require very active personal effort, and will greatly increase their efficiency.

An Unusual Steam Heating Design

A remarkable example of steam heating efficiency under adverse conditions is that of the remodelled heating system in the six-story building at 255 Atlantic avenue, Boston, Mass. A great deal of difficulty and discomfort had been experienced with this installation due to the peculiar circumstances under which it was forced to operate. The solution arrived at was probably unique for its simplicity, effectiveness and the small outlay necessary to bring about these results.

This building is used for both offices and shops. On the ground floor considerable space is devoted to storage of various heavy and cumbersome materials. There is no steam plant and, therefore, the steam necessary for the heating system has been supplied from the power plant of an adjoining building. The original heating outfit consisted of a one-pipe system receiving its steam supply through pipes laid under the main floor. A considerable part of the latter consists of concrete which was laid around the pipes. From the first, trouble was experienced with the heating system. Most of the radiators are of the wall type and made up of a great many sections while others are merely pipe coils running around the walls of the rooms. With such long radiating units of little height it was impossible to obtain sufficient circulation to insure the entire surface being in action. The one-pipe system proved to be entirely inadequate to furnish a satisfactory amount of heat under the conditions existing. Not only was it impossible to make the steam circulate throughout the radiators but also the occupants were constantly annoyed by water hammer and of course the buried pipes under the first floor caused trouble. Expansion and contraction of these pipes cracked the surrounding concrete and, in addition, it was impossible to get at them for repairs or alterations. To make matters worse, leaks were not long in developing in the concrete-housed piping and this further crippled the heating outfit.

It was finally decided to abandon

the one-pipe system and to apply a vacuum system to the building, using as much of the old piping as possible in order to avoid expense. To this end, the old air pipes were utilized for the return lines of the new two-pipe system, although these were no larger than ½ in. and, in some cases, only ⅜ in. The supply side of the equipment was left unchanged, but on the discharge end each radiating unit was equipped with a Webster water seal motor, permitting the escape of water and air and preventing the passage of any uncondensed steam from the radiator into the returns. With this system a positive circulation was secured by the action of the water seal motor combined with a vacuum pump on the return pipe.

In making over this installation the most difficult question to settle was the disposition of the return pipes. To get at the old pipes laid in the floor was impossible without a much greater expense than the job warranted, for not only would it have been necessary to chip out

RETURNS FROM RADIATOR ON GROUND FLOOR, AS CONNECTED TO RETURN MAINS ON CEILING

the concrete in which these pipes were completely buried, but on top of this floor were superimposed tons of steel, stored there by some of the shops in the building. The expense of removing all this stock and then chipping away the floor in order to reach the pipes or to lay new ones would have been prohibitive.

At length it was suggested to run the returns of the entire building on the ceiling of the first floor, some 13 ft. above the ground floor level, and to lift the condensation from the radiators on the first story up to this level by the pull of the vacuum pump. This course was adopted with entire success. The return pipe from each main floor radiator was run vertically to the ceiling, where two elbows and a nipple served to connect it to the upper side of the main return pipe which was run horizontally about 6 in. below the ceiling. The accompanying photograph shows a radiator in the ground floor office of the Edson Mfg. Co. having a by-passed gauge glass for observing the lift action, and the connection of the return riser to the main return line at the ceiling. The vacuum pump, located in the adjacent power house, is a 4" x 6" x 7" Knowles single vacuum pump, and maintains a vacuum on the system varying between 10 in. and 15 in. of mercury. A perfect circulation is obtained with the lower vacuum, and no difficulty has been experienced with the extraordinarily high lift of the main floor returns or, in fact, with any part of the heating system. The old steam pipes still remain buried in the concrete floor.

The heating contractors who installed the present layout are Whitten & Jackson, Boston, Mass.

Fuel Tests with House Heating Boilers are described in Bulletin 31, by J. M. Snodgrass, assistant professor of mechanical enginering, Engineering Department Station, issued by the University of Illinois. The bulletin gives the results of 130 fuel tests. The bulletin, we understand, may be had on application to the University of Illinois, Urbana, Ill.

A Reversible Ventilating System for an Auditorium

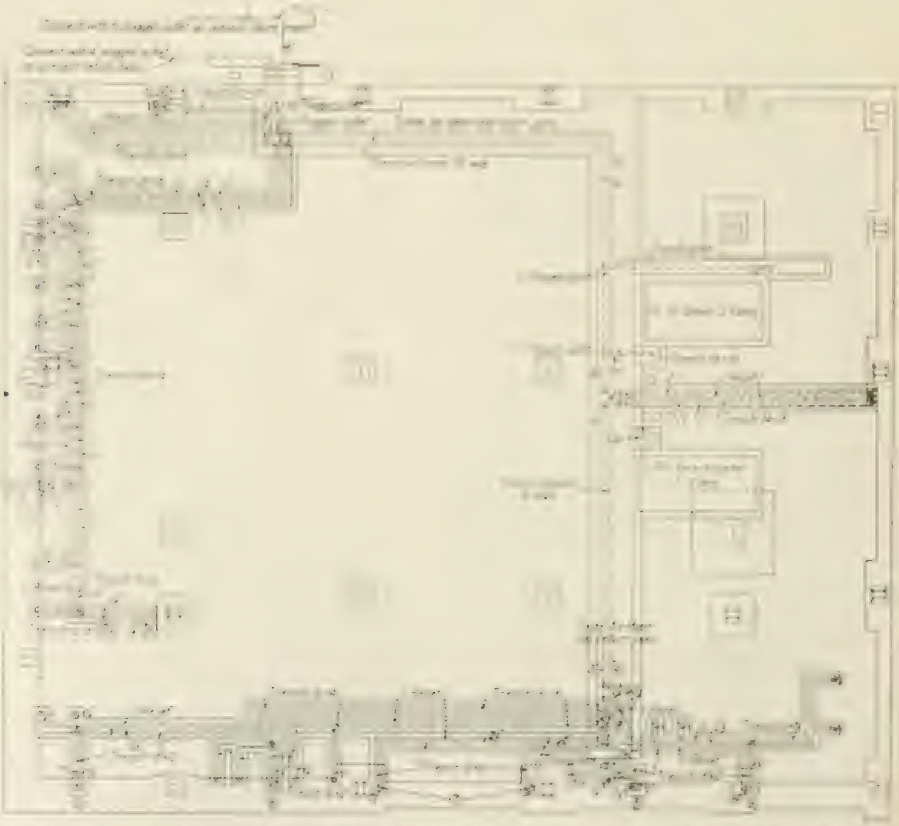
PLANT INSTALLED IN THE SUNDAY SCHOOL OF THE SOCIETY FOR ETHICAL CULTURE, NEW YORK

A comparatively new method of arranging a ventilating system so that, by the turn of a damper, it may be changed from a downward to an upward system, or *vice versa,* is illustrated in the accompanying plans of the Meeting House and Sunday School Room of the Society for Ethical Culture, Central Park West and Sixty-fourth Street, New York.

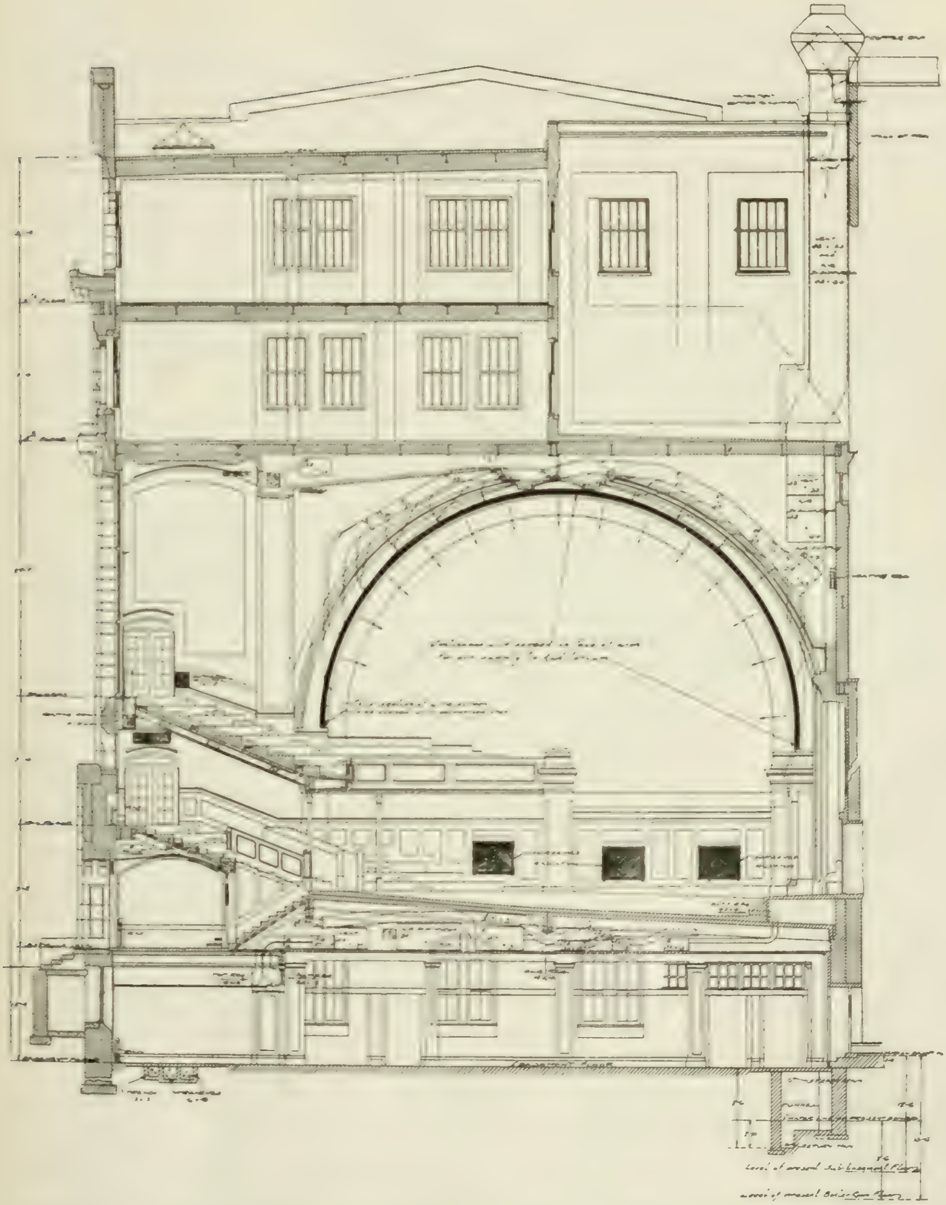
The illustrations show the reversing apparatus in detail, as well as its location in connection with the system itself. The apparatus is arranged to convey the air supply from the blower and the exhaust air to the exhauster in the following manner:

When the reversing damper is set in its regular position, the fresh air supply is conveyed from the blower through the reversing apparatus to the registers and screens near the ceiling, and at the same time the exhaust air is drawn from the registers near the floor through the reversing apparatus and into the exhauster.

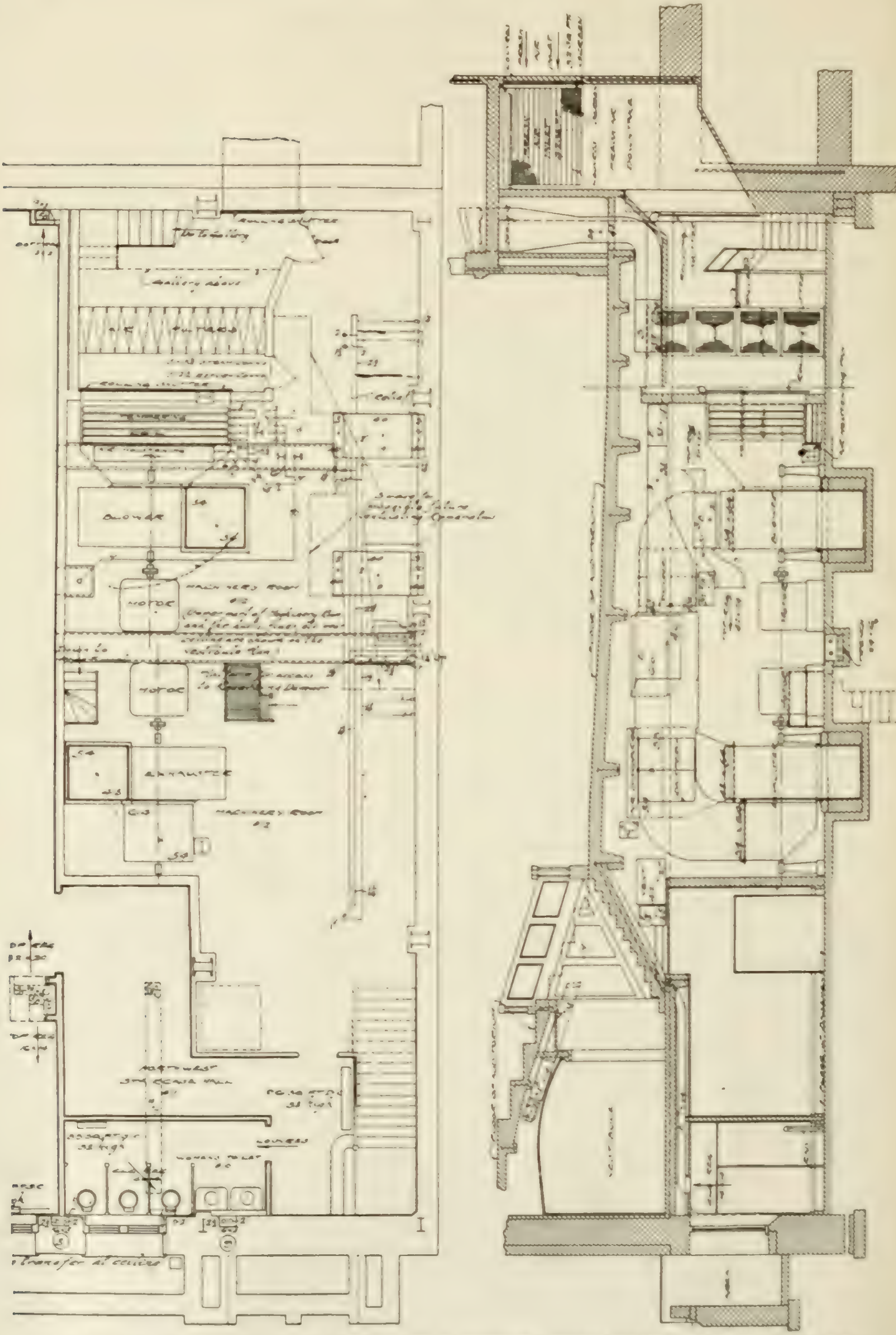
When the damper is set in the reversed position, the air (fresh air supply) is conveyed from the blower through the reversing apparatus to the registers near the floor (ordinarily the exhaust registers) and the exhaust air is drawn from the registers and screens near the ceiling (ordinarily



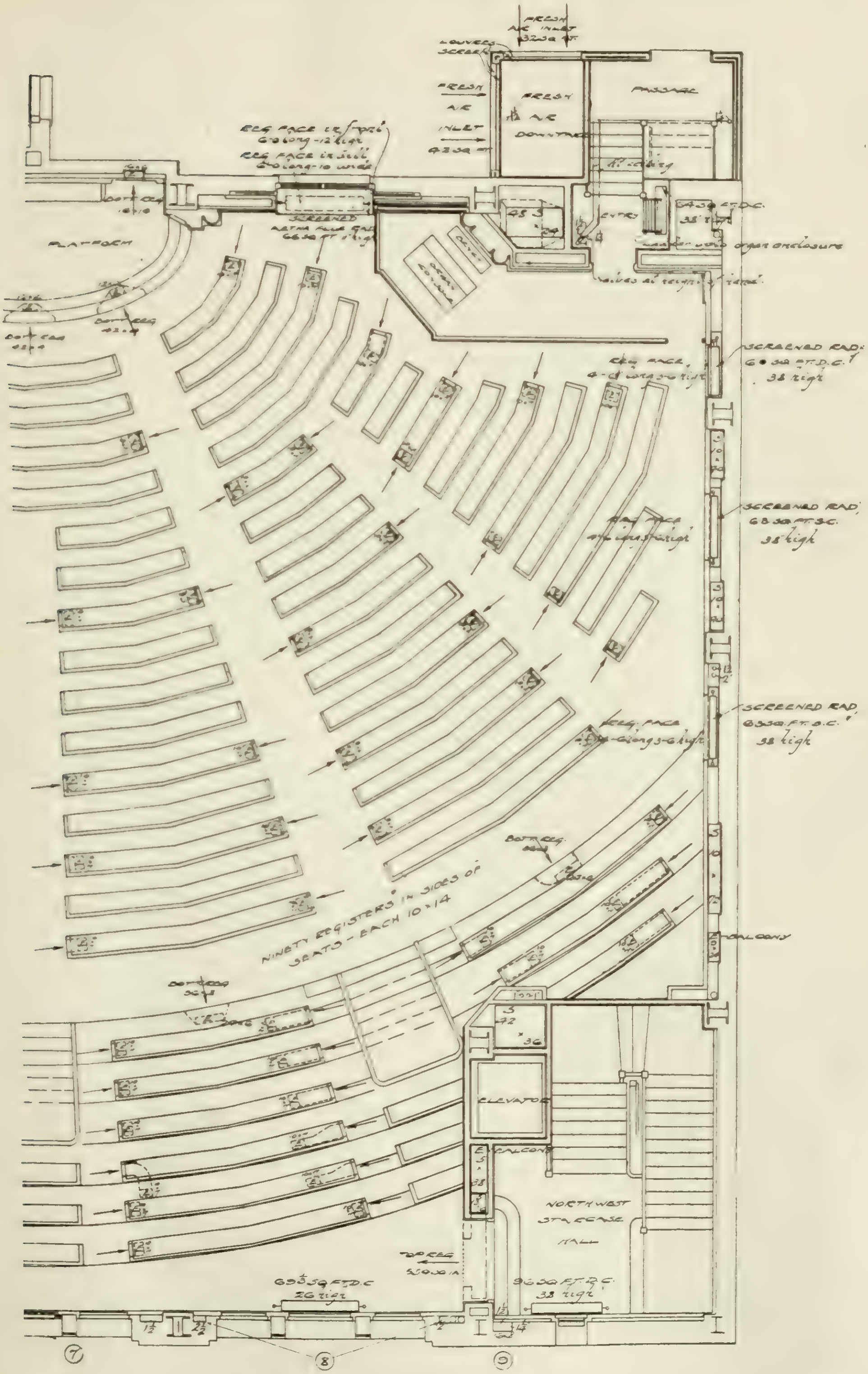
PLAN OF PIPING AND TRENCHES IN BASEMENT OF MEETING HOUSE AND SUNDAY SCHOOL, SOCIETY FOR ETHICAL CULTURE



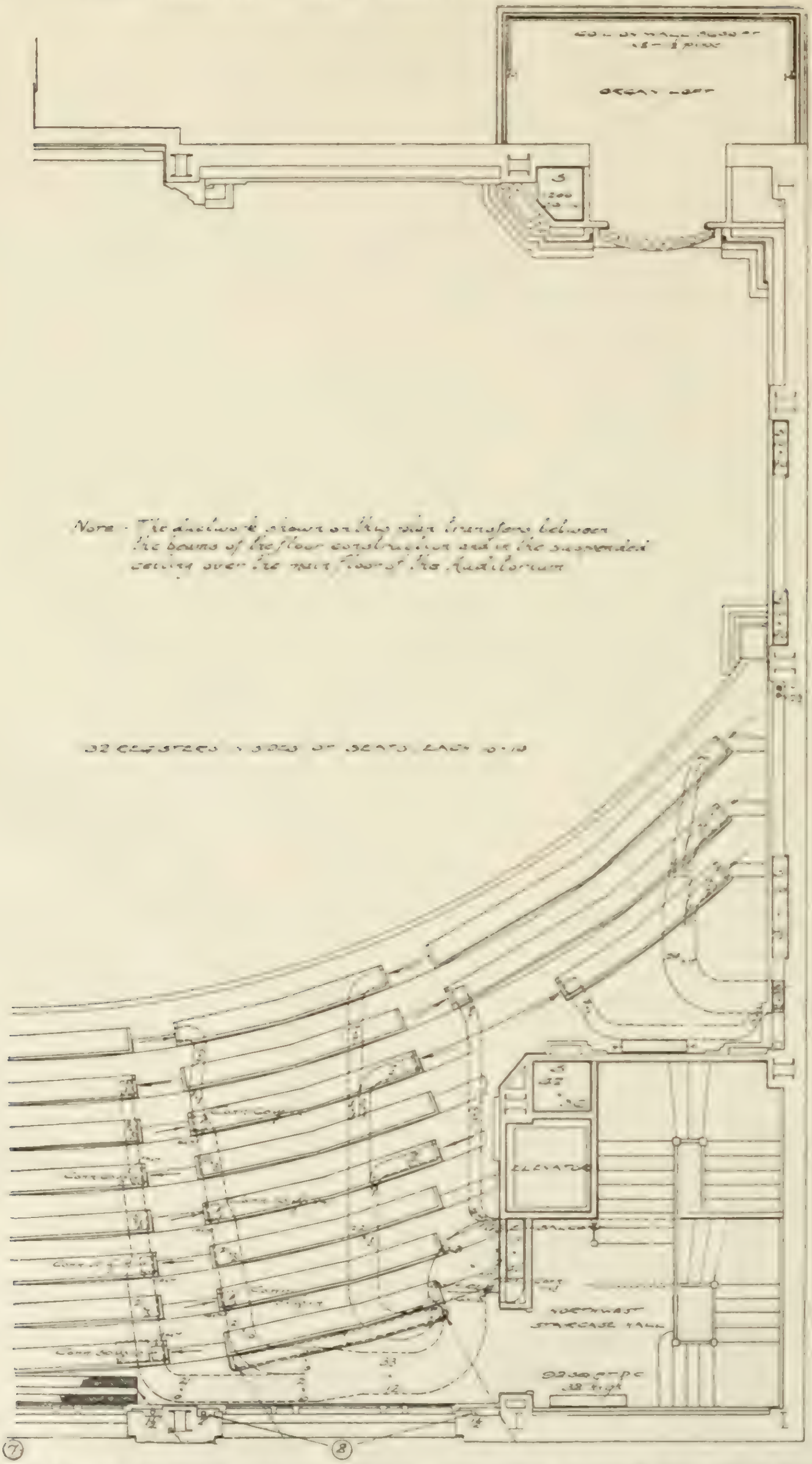
SECTIONAL ELEVATION, MEETING HOUSE AND SUNDAY SCHOOL, SOCIETY FOR ETHICAL CULTURE, SHOWING SCHEME OF HEATING AND VENTILATION



PLAN AND ELEVATION OF PORTION OF BASEMENT, CONTAINING HEATING AND VENTILATING APPARATUS, MEETING HOUSE AND SUNDAY SCHOOL, SOCIETY FOR ETHICAL CULTURE



HALF PLAN OF MAIN FLOOR, MEETING HOUSE AND SUNDAY SCHOOL, SOCIETY FOR ETHICAL CULTURE, SHOWING EXHAUST AIR OPENINGS AT ENDS OF SEATS



HALF PLAN OF BALCONY FLOOR, MEETING HOUSE AND SUNDAY SCHOOL, SOCIETY FOR ETHICAL CULTURE, SHOWING VENTILATING SYSTEM

the supply outlets) through the reversing apparatus and into the exhauster. The scheme is similar to that designed by the same engineers for the New Theatre, New York.

The building is heated by direct steam, supplied at about 5 lbs. pressure from the present school building directly adjoining the Sunday School at the north wall. The condensation returns by gravity.

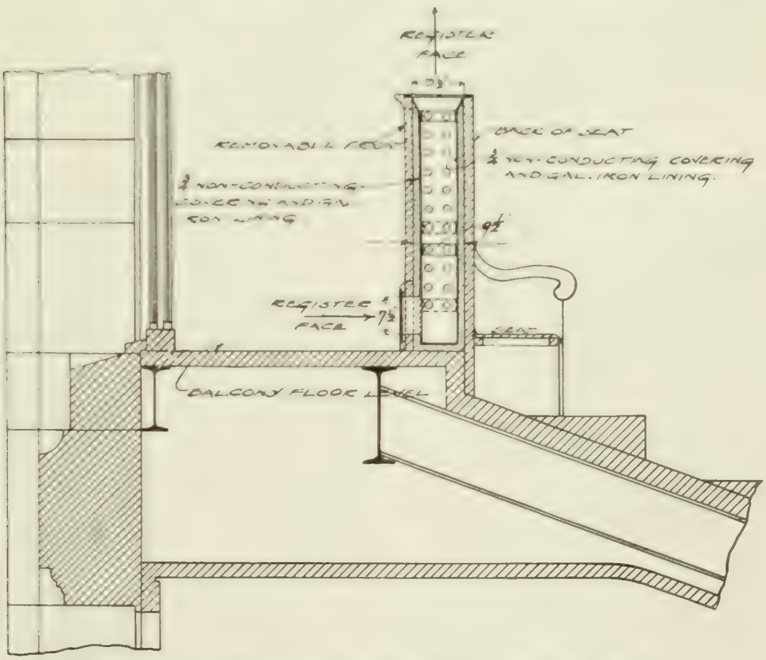
All of the pipe mains are run in trenches on the basement floor. The horizontal return mains are thus run below the water level in the boilers, securing a sealed return.

The ventilating apparatus provides for a tempered fresh air supply and exhaust ventilation for the auditorium and a separate system of air supply and exhaust ducts and flues for the ventilation of the basement, arranged in such a way that the apparatus may be used for the ventilation of either the auditorium or basement.

Included in this apparatus are tempering coil and motors, air supply and exhaust fans and provisions for the future installation of air moistening pans. The air supply fan is of the Sturtevant type, having a wheel 8 ft. in diameter, and is 4 ft. 6 in. wide. The fan for exhaust ventilation is also of the Sturtevant type, having a blast wheel 7 ft. 6 in. in diameter and a width of 4 ft. Both fan wheels have curved blades and are enclosed in full steel-plate housings, extending below the floor level. All the blowers and fans are driven by C. & C. variable-speed motors built especially for the purpose by the Garwood Electric Company.

The tempering coil for the 8-ft. blower has 1515 sq. ft. of heating surface made up of five 2-row sections, 11 ft. wide by 7 ft. high, making a coil 10 rows deep. The sections are made up of 1¼-in. pipe screwed into separate cast-iron headers.

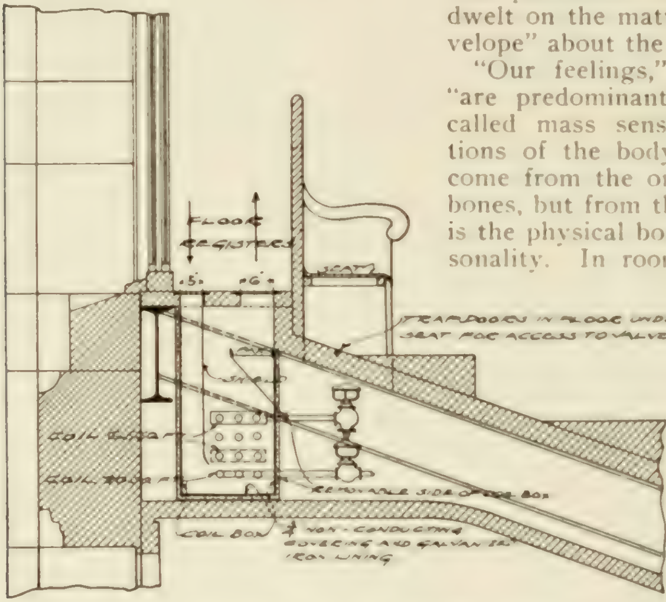
Provision is made in the casing of the tempering coils for the future installation of air moistening apparatus, and swinging doors in the casing provide access to the sections as well as to the air moistener.



DETAIL OF SCREENED HEATING COILS BEHIND SEATS

As will be seen from the illustrations, the reversing apparatus for the ventilating system consists of a heavy steel-plate swinging damper, enclosed

in a reinforced steel casing. The damper can be operated by hand and the operating lever is provided with locking devices for clamping the damper in either position.



DETAILS OF COILS UNDER BALCONY FLOOR

The air enters the downtake shaft near the street level and is drawn through cheese cloth filters located in a gallery forming a fresh air chamber. After passing through the tempering coil the air is moistened and flows through ducts to the various outlets.

The heating system is controlled by the Johnson system of temperature regulation.

The heating plant is equipped with the Paul vacuum system.

The architect of the building is Robert D. Kohn, New York, and the work was designed by Nygren, Tenney & Ohmes, New York. The heating contractors are Baker, Smith & Co., New York.

Ventilation and the Body's Air Envelope

The recent address before the Heating and Ventilating Engineers' Society, of Dr. Luther H. Gulick, director of the Department of Child Hygiene of the Russell Sage Foundation, on the subject of ventilation, has aroused so much discussion in engineering circles that, at our request, he has put into concrete form that portion of his remarks which dwelt on the matter of the "air envelope" about the body.

"Our feelings," said Dr. Gulick, "are predominantly related to so-called mass sensations, the sensations of the body. They do not come from the organs or from the bones, but from the skin. The skin is the physical boundary of the personality. In rooms where the air, even though good, is stationary, the blood-vessels of the skin are dilated and thus the skin is flushed with blood. But the skin should not be so flushed with blood at a time when the brain must be flushed with blood in order to do its work.

"If the air in a room is stationary, that part of the air which comes closest to the body becomes enmeshed in the underwear and so becomes damp and warm. In the endeavor to reduce the temperature the skin starts up a gentle perspiration (because evaporation reduces heat) and the body is enveloped in a warm, moist atmosphere which produces useless perspiration, the air next the body being already saturated. This high temperature and excess moisture cause great restlessness. It is not because school children are overworked mentally, but because the material conditions are such as to demand the preponderance of blood circulation in the

peripheral parts of the body, that children are restless in school.

"Now, open all the windows in the schoolroom, and if you have a plenum system and do not want to throw the children into paroxysms, open all the windows of the building at once and lower the temperature as much as possible in five minutes. During those five minutes have the children walk up and down so fast that they will not catch cold. Then we get the effect of cold impinging against the skin. The layer of damp, moist air has been swept away from the body and a colder layer has taken its place and driven the blood from the surface and it is available again for the brain. This all shows that there are other features in ventilation that are just as important as the purity of the air."

Friction in Steam Pipes When Flow of Steam and Condensation Are in Opposite Directions

The matter of friction in steam pipes when the condensation is flowing in the opposite direction to that of the steam was discussed by James A. Donnelly at the recent annual meeting of the Heating Engineers' Society.

Referring to the illustration, Mr. Donnelly stated that "if the steam is flowing in the pipe in the direction of the arrow, and the condensation is coming in the opposite direction, we expect a reasonable pitch in the pipe. That is probably somewhat exaggerated in the drawing. But it is possible to figure very closely the head of water which must be maintained at Point A in order to balance the velocity head of the flow of steam.

"This is a very nice illustration of the conversion of a velocity-head of steam into a static-head of water. For instance, if the velocity-head is is 16 feet per second, which is higher than one-pipe radiator practice, the head of water at Point A necessary to balance the velocity-head at the bottom would be about 0.03 inches. A smaller head of water would result in the water being blown back until the water accumulated and balanced it. The water would then have to rise somewhat higher in order to flow in the opposite direction. This head of water becomes more serious in pipes of small size, and

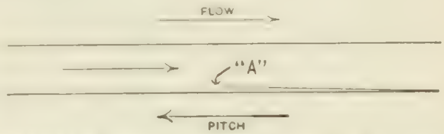


DIAGRAM SHOWING FRICTION IN STEAM PIPES

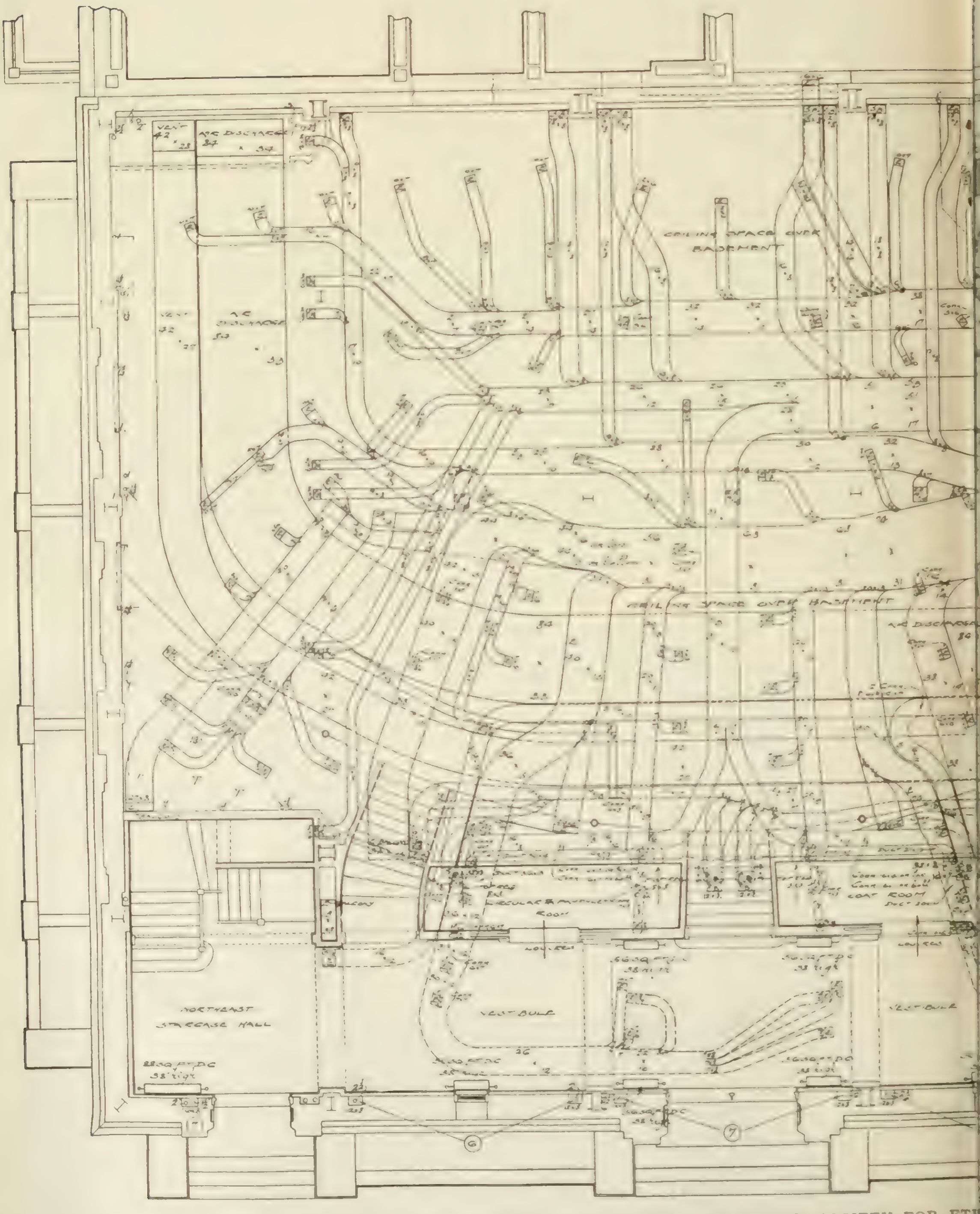
much more serious with higher velocities.

"With a velocity of 32 feet a second, it is 0.12 inches; with 64 feet a second, which is not getting up very high, it is 0.48 inches; with 128 feet a second, which is quite high, it is almost 2 inches—1.92 inches. That would be the minimum height of the condensation which would balance the velocity-head of the steam in the opposite direction.

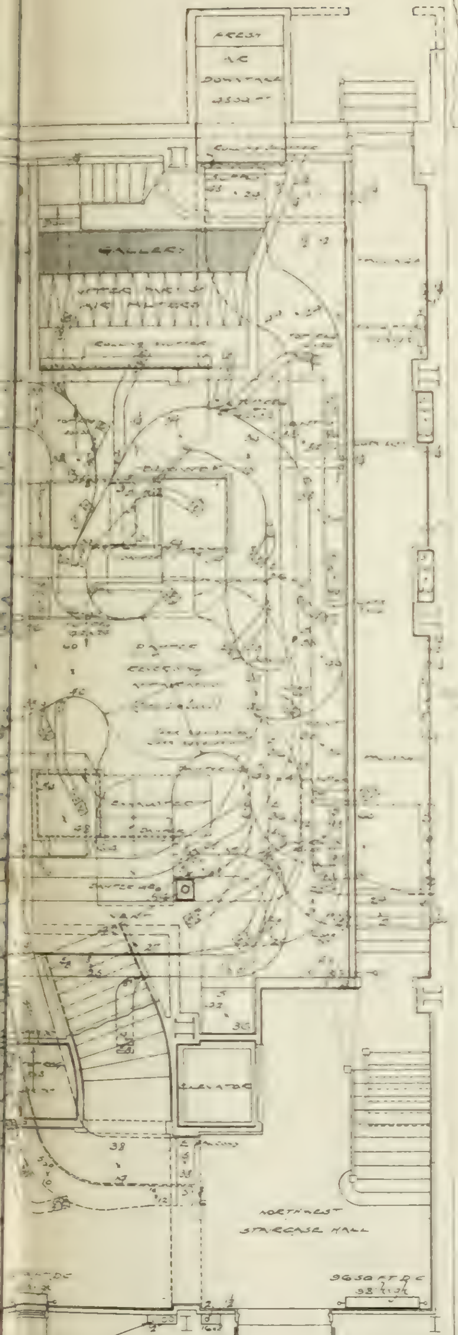
"To my mind, one of the most necessary things to know in connection with circulating steam is what these velocities should be for different-sized pipes, and to know the sort of drainage we are getting, to know when the condensation is being blown up the riser and to know when the condensation is really running back.

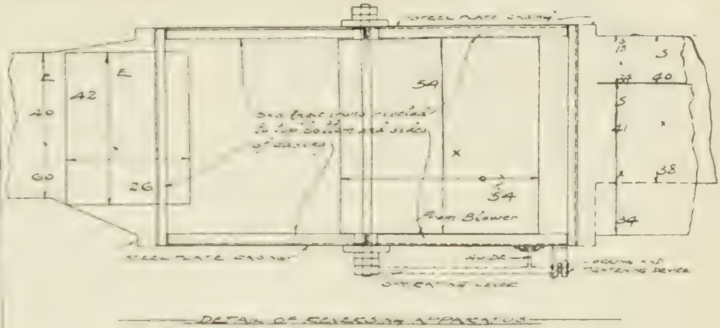
"I have visited plants where the specifications read that the water of condensation should run back against the flow of steam where the water did not run back at all, but was carried in the opposite direction to some drip point."

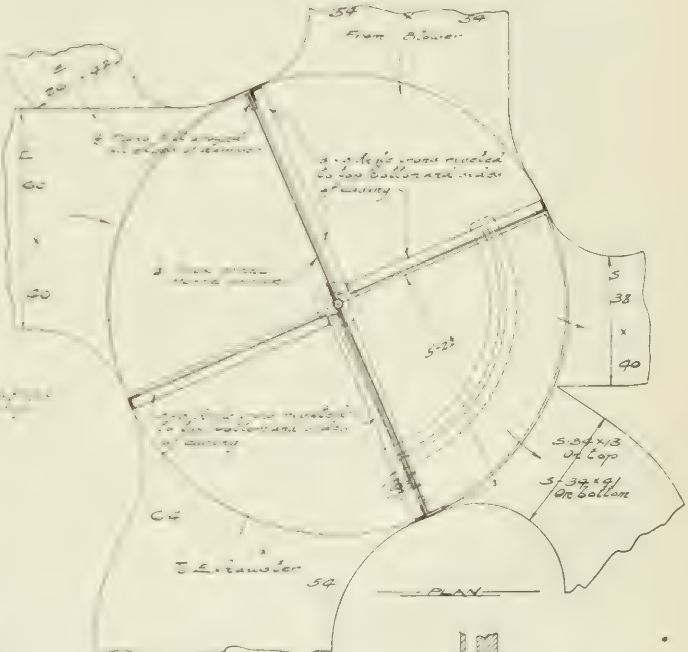
The preliminary plans for the Panama-California Exposition, to be held in San Diego, Cal., in 1915, indicate that the exposition buildings will present a concrete idea of the whole art of Spanish Colonial architecture. The exposition management has retained Bertram G. Goodhue, of Boston, as architect, and has also secured the services of three of the foremost exposition builders in the country to create the "Mission City" that men have dreamed of for 300 years. Ground will be broken in July of this year for the first of these exposition buildings.

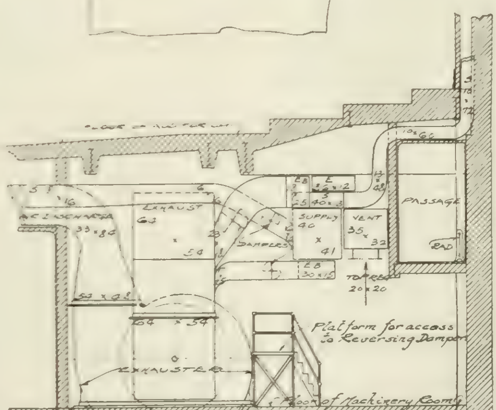


VESTIBULE PLAN, MEETING ROOM AND SUNDAY SCHOOL, SOCIETY FOR ET









THICAL CULTURE, SHOWING AIR DUCTS AND DETAILS OF REVERSING APPARATUS

THE HEATING AND VENTILATING MAGAZINE

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THE past month has been marked by a noteworthy impetus to the cause of compulsory legislation. Indiana has swung into line with a satisfactory ventilation law relating to school houses. Kansas has just passed an equally satisfactory law embracing the ventilation of public buildings, including churches, moving picture show buildings and similar quarters. The New York legislature has now before it a factory and workroom ventilation bill which, it is said, has a good chance for passage and which is, under the circumstances, a fairly satisfactory measure. Finally, in New York City, Mayor Gaynor has just appointed a commission on moving picture shows, which, we are able to state, will devote particular attention to the sanitation of such places, with special reference to their proper ventilation.

IF unsettled trade conditions amount to anything in bringing together the affected interests, the forthcoming convention of master steam and hot water fitters in Chicago May 29-June 1 has an extraordinary opportunity to distinguish itself in the furtherance of the association idea. Chicago has been for some time in the grip of a bitter strike or, more properly, hold-up, in which the contending parties are the United Association of Plumbers and the International Association of Steam Fitters. In this quarrel, in which the employers have no part, the plumbers' association appears to be the aggressor in seeking to force the amalgamation of the steam fitters' with its own association. Violence has already marked the so-called strike and has led, moreover, to sympathetic strikes in other lines in an endeavor to sustain or break, as the case may be, the steamfitters' union. Several of Chicago's important buildings, now under construction, are tied up as a result of this peculiar labor war and, at this writing, the end is not yet in sight.

All who have had experience in association work will recognize at once the powerful argument afforded by such an object lesson for promoting closer relations among the employers. That the employers in Chicago have heeded the danger signal is noted in the increased membership of their local association. We believe that the display of wise statesmanship would pave the way for, if not actually bring about, the affiliation of the Chicago master fitters with the national association at this time. In any event, it is easy to surmise that the conditions described will lead to a distinctly forward movement on the part of the master fitters of Chicago and of the Middle West.

Central Station Heating

2—RATES

By Byron T. Gifford

(This series of articles commenced in the April issue with a discussion of Pipe Line Losses.)

It is this subject that affects the income of the heating plant, but the income is not directly proportional to the rate charged for the service, neither is it universally proportional to the rate. In fact, the rate we want is that which will give us the largest net earning per dollar invested, and at the same time serve the greatest number of people in a community, for we must not get away from the fact that a central station heating plant is a public utility, which means a public servant.

Up to the present time public utility commissions have not handed down any noted decisions relative to central station heating rates, but it is only a matter of time before this subject will be given careful consideration by the commissions and then, if not before, the subject of rates on heating will be standardized.

There are at this time two different methods used in charging for service,

(1) Meter basis.
(2) Flat rate basis.

The flat rate basis is subdivided again into two methods,

(1) Square foot of radiation basis.
(2) Cubic foot of contents basis.

There are, of course, advocates for each method. The writer knows of one large heating company which, after being on a meter basis, took out all meters and charged on a per square foot of radiation basis, because it claimed that it took too much time and money to watch the meters and adjust the bills each month. This trouble, it seems to the author, could have been obviated by careful installation and inspection of the meters. There will be without doubt many improvements in the steam meters, or rather in the method of using them. Also, a meter will be devised that will measure hot water heating service, but at present the flat rate is the only practical rate for hot water service.

It is not the intention of the author to advocate either method, as against the other, but rather to take for granted that both have come to stay, as is undoubtedly the case, and point out wherein the net results are affected by the rate to be charged in either case.

In any steam heating franchise granted in these days, the municipality will and should demand that the rate be stated plainly, and, in such a franchise, both meter and flat rates should be given, for the benefit of the company, as well as for the benefit of the city; for the company, because at some time it might be necessary to serve consumers on either basis or both bases, and for the city,

because it allows the consumer the choice of either system. The rates in this event should be equally equitable to both the consumer and the company.

Some consumers would rather pay more money per year, and know what they are to pay, than to be disappointed each month with a bill that they will invariably think is too high, and, on the other hand, there will be many consumers who will want the meter basis so that they can save money. Under any condition the consumer must be satisfied, and both methods are, therefore, advisable.

In a hot water heating franchise the meter rate is not necessary, because there are no meters on the market. When they do come, they will probably be the heat unit meter, and in that event 1,000,000 B.T.U. would be the logical basis of charge.

On a meter basis for steam heating, 1000 lbs. of steam is the basis of charge.

On a meter basis for hot water, 1,000,000 B.T.U. will probably be the basis of charge.

On a flat rate basis for hot water or steam heating the charge per annum or per season is either per square foot of radiation or per 1,000 cu. ft. of space heated.

When the charge per square foot of radiation is used as a basis it should be stated clearly that it is the radiation required to heat the building and not the radiation that is set in the building. The required radiation is the amount necessary to set so that the company can guarantee to maintain a comfortable temperature.

The rules for figuring these requirements should be plainly set out and should be rules that have been found reliable. The company should not be obliged to serve any building that is not equipped with at least the required amount of radiation. For if it did, it could not give satisfaction and that would be suicidal for the company and disagreeable to everyone concerned. The question has been asked many times, "Why do you require that I set a radiator in the guest's bed-room? We never use it and don't want it heated. We always have the door to this room closed," etc. It is, however, very easy to open the door and "take the chill off this room," and while doing it take the heat away from the rest of the house or take the heat away from the heating company without paying for it. One is as bad as the other. For that reason all rooms in the building should be equipped with the proper-sized radiators or, at least, the building should contain, in total, the required amount of radiation and the consumer should pay for the full requirements even though he does shut his bedroom radiator off at night, for in the morning, when he turns it on, he demands the capacity at the plant and in the mains to furnish that heat, and the company is reserving capacity in its mains and in its station to take care of him at all times. In other words, he demands a certain service that must be in reserve for him and for that reason he should not object to pay for it at a reasonable price.

With the flat rate per square foot basis, thermostatic control is almost essential to good operation and economical use of heat in the residences and buildings. With its use a more even distribution of heat is obtained over the entire heating system and an even temperature will be assured to all consumers. This device also saves the waste of heat and allows a lower rate to be charged for what is better service. There is, therefore, a twofold advantage in using thermostatic control, and it accrues to the interest of the consumer as well as to the company, on a flat rate basis.

The flat rate basis charge, of so much per thousand cubic feet of space, is not as equitable as the per square foot of radiation basis. For each and every 1000 cu. ft. of contents do not require the same amount of heat, owing to the difference in location and difference in use. For instance, 1000 cu. ft. in a corner drug store requires more heat at zero outside than does 1000 cu. ft. in a dentist's office at zero outside. This method is not used very much at the present time.

Meter rates should be based either on what it actually costs to give the service, plus a profit which is fair and equitable, or, if this information is not available, the rates can be based upon data from other towns of similar conditions, relative to outside temperature, price of fuel, cost of construction, etc. Under any condition, the company or the city, if a franchise is being granted, could afford to consult a central station heating engineer and get his report on the proposition.

Fifty cents per thousand pounds of steam condensed is approximately equal to fifty cents per 1,000,000 B.T.U., assuming 1 lb. of steam to liberate 1000 B.T.U., when condensing in a heating system.

The cost to the company to give heating service is made up of the following items, which should be figured on a basis of 1000 lbs. of steam generated or a multiple of that quantity.

Generating cost.	Taxes and insurance. Fuel. Water. Supplies. Repairs and renewals. Labor. Depreciation based on cost of generating station and machinery.
Distribution cost.	Taxes and insurance. Line loss in pounds of steam. Labor. Repairs and renewals. Depreciation based on cost of distributing system.
General, pro rated into above two.	Management, general expenses, and fixed charges.

In figuring on a new plant these costs should be figured for the conditions under consideration and a careful study of these conditions should be made.

The cost of hot water heat is computed the same way as for steam except the basis of figuring is per 1,000,000 B.T.U. generated.

The flat rate charged for steam or hot water per square foot of radiation per season is based upon the average number of heat units given off by the radiation, plus that given off by the pipe line, plus that given off by the piping in the buildings, which is approximately 5 per cent. in the first case, in a well constructed pipe line, and 5 per cent. in the second case, if the pipes are covered.

Take, for example, a city with an average temperature of 40° F. during the heating season. Average temperature of building = 70° F. Average temperature of circulating water in radiator (average wind), 140° (180° schedule); difference in temperature between room and radiator, 70° F. B.T.U. emitted per square foot per hour = $1.65 \times 70 = 115.5$ B.T.U. plus 10 per cent. ($5 + 5$) for line and piping loss = 127 B.T.U. per hour.

A heating season from October 1 to May 15 is equal to 227 days or 5548 hrs. 5548 hrs. is the total number of hours in the average heating season, but there are about 350 hrs. during the average season that heat is not needed, and for that reason 5200 hrs. can be considered as the average heating hours in a season.

$5200 \times 127 = 660{,}400$ B.T.U. per season, including line and piping loss.

$5200 \times 121.2 = 630{,}300$ B.T.U. per season used in a building, provided each square foot of radiation is so set and figured as to emit an average of 121.2 B.T.U. per hour.

Now we can see that the cost of this service depends entirely, if on the flat rate basis, upon the number of B.T.U. emitted by the

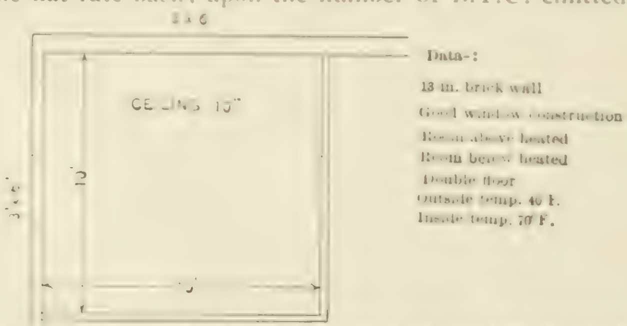


FIG. 1 TYPICAL ROOM IN 10 ROOM HOUSE AS USED IN CALCULATIONS

radiator per hour. There is another feature that enters into this calculation that materially affects the result. The amount of heat given off by the radiator is directly proportional to the amount needed to heat the room or building in which it is placed, provided, of course, that thermostatic control is used, for when the room is up to its required temperature the supply of heat will be shut off and the heat unit consumption reduced. To check this yearly B.T.U.

consumption, assume a 10-room house with each room the same as shown.

B.T.U. required per hour =

$$\text{Cubic contents} = \frac{10 \times 10 \times 10 \times 30}{50} = 600$$

$$\text{Glass surface} = 2\,(3 \times 6) \times 34 = 1224$$

$$\text{Exposed wall surface} = ((20 \times 10) - 36) \times 9 = 1476$$

	3200 B.T.U.
Exposure	320
	3520 B.T.U.

Radiation required for this room for —10° F. would be in C. S. hot water 60 sq. ft., and assuming 115.5 B.T.U. per square foot per hour we would have a B.T.U. consumption of 6900, which shows that about 50 per cent. of the time, at a temperature outside of 40° F., the radiator would be shut off, if thermostatic control is used.

5200 (hours) × 3520 B.T.U., 60 sq. ft. radiation = 304,720 B.T.U. per sq. ft. per season.

At the rate of 50c. per 1,000,000 B.T.U. the consumption would cost about 15.25c. plus 5 per cent. piping loss or about 16c. per square foot.

It should not be considered that thermostatic control will save 50 per cent. of the average heat consumption, for it will not, due to the fact that the consumer will shut off the radiators part of the time if the temperature of the building gets too high and, on the other hand, the occupants will demand fresh air, even with thermostatic control, and will open the window. About 30 per cent., the author believes, can be saved this way and, in addition, a more even and delightful service can be rendered to the consumer. In addition, therefore, to the above 16c. we must add about 40 per cent. or about 6c., which will bring our cost to the consumer up to 22c. per foot per season, if we assume the selling price to be equal to 50c. per 1,000,000 B.T.U., and this price has been assumed here only for comparison and not as any standard.

The Wisconsin Railroad Commission, in its reports, Vol. 2, page 302, states that, with coal at $2.00 per ton, exhaust steam could be sold at 50c. per 1000 pounds safely; that is, with a secure profit, but it also states that where live steam is sold there would be small profits unless large quantities of steam were sold.

The cost to the company should be analyzed and compiled carefully. This will be taken up in detail under "Operation and Management."

Whether on a flat rate or a meter rate, the amount of radiation set and the amount required are important for the management of a heating plant to know and a record of this data should be kept on file in the office of the company.

In making a rate for service per season it is desirable to know the percentage of heat used in any one month during the heating

season for two seasons: First, the collections are often made monthly; second, it sometimes happens that a credit or debit is given for certain months during the season, when the service is started or stopped in mid-season. The following table will be useful in this connection:

Heat Consumption Table

Heat used up to Oct. 31	6%
From Oct. 31 to Nov. 30	12%
From Nov. 30 to Dec. 31	18%
From Dec. 31 to January 31	21%
From Jan. 31 to Feb. 28	19%
From Feb. 28 to March 31	13%
From March 31 to April 30	8%
From April 30 to May 15	3%
	100%

The following division is used extensively in flat rate contracts and is easily remembered by the consumers.

5% of contract price payable October 1.
15% of contract price payable November 1.
20% of contract price payable December 1.
20% of contract price payable January 1.
20% of contract price payable February 1.
15% of contract price payable March 1.
5% of contract price payable April 1.

This gives the heating company its money partially in advance, but is no hardship to the consumer because, as a rule, if he operates his own furnace or boiler, he buys his coal in the summer and pays for it long before he uses it; therefore, paying on the above schedule allows him to pay his heating bill in several installments during the season.

It is often necessary to pro rate a heating bill, and for that the following table has been made from the above heat consumption table:

Table of Heat Consumption for Pro-Rating Heating Charges on Flat Rate

Assuming Oct. 1 as the start of the season.
Assuming May 25 as the close of the season.

For each day in October	6/31% = 0.194%
For each day in November	12/30% = 0. 40%
For each day in December	18/31% = 0. 58%
For each day in January	21/31% = 0.677%
For each day in February	19/28% = 0.678%
For each day in March	13/31% = 0.417%
For each day in April	8/30% = 0.267%
For each day in May	3/15% = 0. 20%

As an example, assume that a building requiring 1000 sq. ft. of steam radiation at 40c. per square foot per season was connected

November 21. What will the bill be for heating on the 30th of November and for the balance of the season? From the table, we find that 0.4% is the proportion of the annual charge for each day in November. For nine days in November the bill would be 9 × 0.4 = 3.6% of $400.00 = $14.40. For the balance of the season the bill would be 82% of $400.00 = $328.00 plus $14.40 = $342.40.

After a building is once connected for a season it is bad policy for the heating company to allow a consumer to discontinue the service for a short time with a full rebate, because of the fact that the company has invested its capital in the service lines and mains to serve this consumer and the company must also reserve capacity in its mains and station to serve this consumer, when he again wants the service. This is often asked of a heating company when a consumer is going away for a month or six weeks. If the consumer is on a meter basis this condition can be handled by means of a minimum charge, but on the flat rate basis the better and more equitable thing to do is to disconnect 50 per cent. of the radiation and charge full rate for the remaining 50 per cent. If the consumer is wise he will leave his house heated thoroughly while away, because of the fact that less damage will be done to the plumbing if the house is heated in cold weather and his furniture and woodwork will be better preserved in an even temperature.

Assume, now, that on February 17 the building above mentioned was to be closed up and approximately 50 per cent. of the radiation disconnected, leaving 560 sq. ft. connected. This condition continued until April 10, when the owner returned and all radiation was again connected. What credit should be allowed?

Answer:—

560 feet × 40 = $224.00 per year.

From table:—

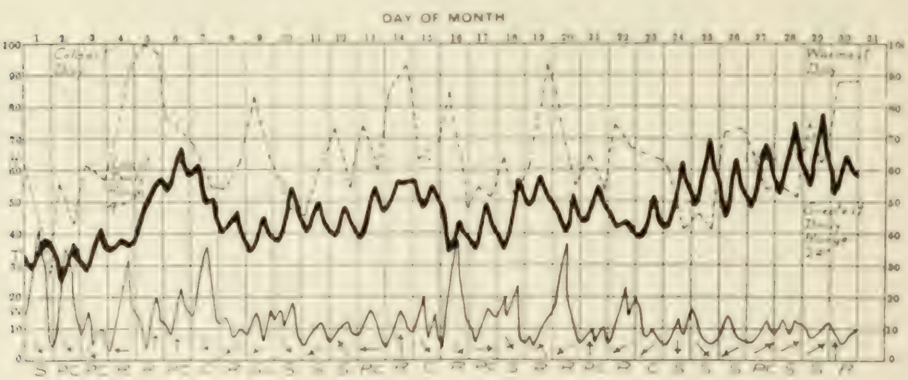
11 days in February	= 11 × 0.678% =	7.458%
31 days in March	= 31 × 0.417% =	13.000%
10 days in April	= 10 × 0.267% =	2.67 %
Percentage of season that the credit is allowed on		23.128%
23.128% of $400.00		= $92.51
23.128% of 224.00		= 51.80
		$40.71

The author advises that never more than 50 per cent. of the radiation be disconnected and, whenever any radiation is disconnected, the heating guarantee should be discontinued by the heating company.

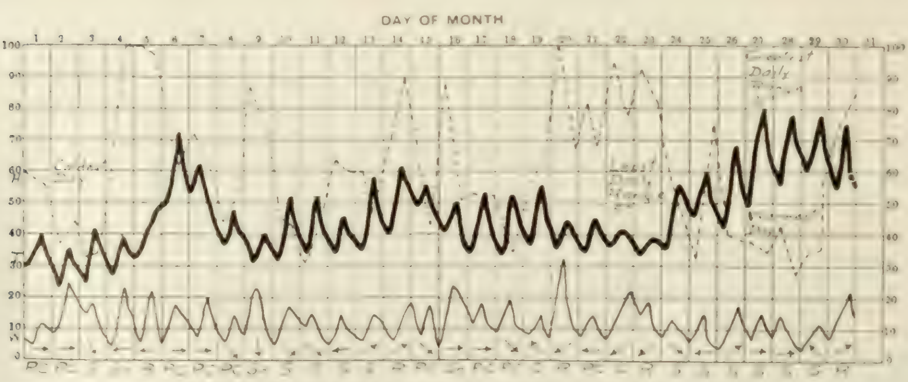
The "Ready to Serve" or "Maximum Demand" theory of charge in connection with the use of meters is a very equitable way of charging and is one that is rapidly coming into favor. This method will be discussed in the next paper, which will appear in the June issue.

The Weather for April, 1911

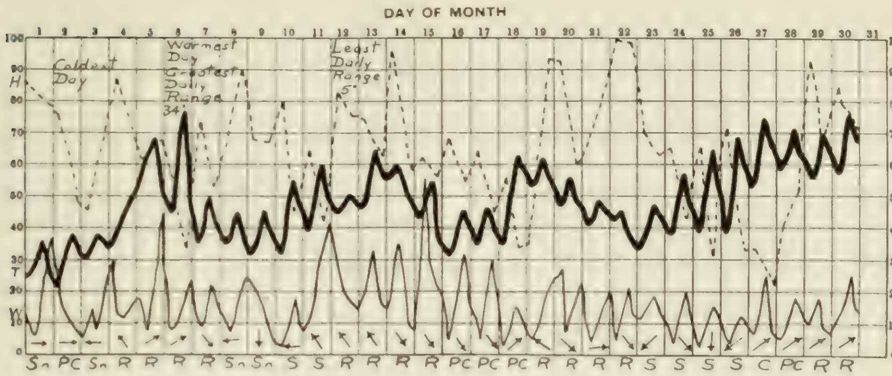
	New York	Boston	Pittsburg	Chicago	St. Louis
Highest temperature, degrees F	78	80	78	70	74
Date of highest temperature	29	27	6	27	17
Lowest temperature, degrees F	24	23	22	27	32
Date of lowest temperature	2	2	2	1	7
Greatest daily range, degrees F	24	31	34	18	25
Date of greatest daily range	29	27	6	11	13
Least daily range, degrees F	4	5	5	5	5
Date of least daily range	4	22	12	8	11
Mean temperature for month, degrees F	48	46	48	46	54
Normal mean temp. this month, deg. F.	49	45.3	51	46.3	56
Total rainfall, inches	3.06	2.28	5.42	3.03	7.46
Total snowfall, inches	0.9	7.7	5.9	2.4	0.0
Normal precipitation, this month, inches	3.30	3.55	2.90	2.88	3.52
Total wind movement, miles	8120	8246	9202	9677	8030
Average hourly wind velocity, miles	11.8	11.5	12.8	13.4	10.2
Prevailing direction of wind	N. W.	West	N. W.	N. E.	S. E.
Number of clear days	10	11	7	10	10
Number of partly cloudy days	11	11	10	5	8
Number of cloudy days	8	8	13	15	12
Number of days on which rain fell	13	8	18	18	13
Number of days on which snow fell	1	3	4	1	0
Snow on ground at end of month, inches	None	None	None	None	None



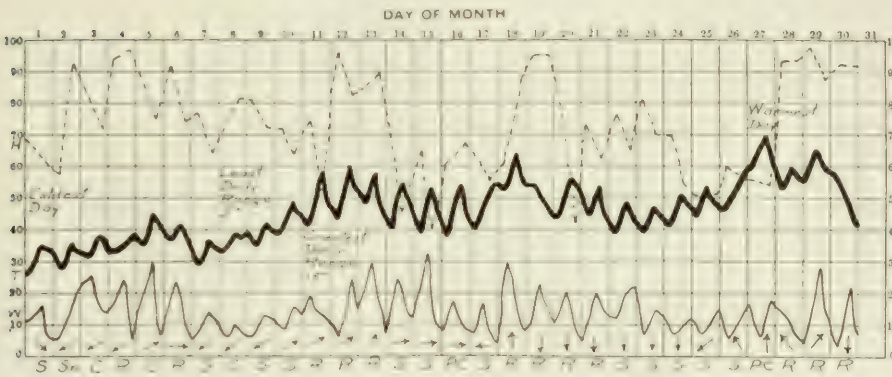
RECORD OF THE WEATHER IN NEW YORK FOR APRIL, 1911



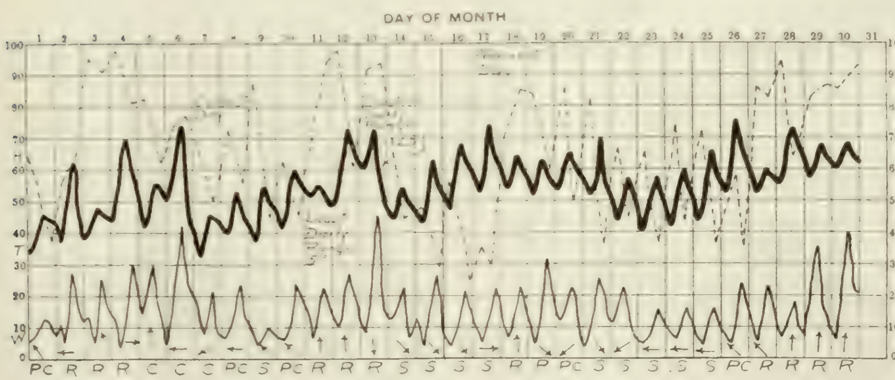
RECORD OF THE WEATHER IN BOSTON FOR APRIL 1911



RECORD OF THE WEATHER IN PITTSBURG FOR APRIL, 1911



RECORD OF THE WEATHER IN CHICAGO FOR APRIL, 1911



RECORD OF THE WEATHER IN ST. LOUIS FOR APRIL 1911

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A.M. and 8 P.M.

S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—Snow.

Arrows fly with prevailing direction of wind

New Ventilation Law in Kansas

Kansas has joined the growing ranks of the compulsory ventilation law States, by passing a measure requiring the proper ventilation of theatres, picture shows and other public buildings, including churches.

The new law is called a "Fire-Escape Inspection and Theatre Ventilation Law," and is to be found in Chapter 197, Laws of 1911, entitled "An Act to provide for better protection of the health and safety of people who assemble in public halls, public houses of entertainment, theatres and places of amusement, tenement houses, apartment houses, rooming houses and other places, and regulating the same and providing penalties for the violation thereof, and repealing Chapter 149, Session Laws of 1909." The law was approved March 14, 1911, and published March 27, 1911.

That part relating to ventilation is contained in the following sections:

VENTILATION OF THEATRES AND PICTURE SHOWS

Sec. 4. It shall be unlawful for the owner, proprietors or lessee to operate any theatre, picture show or place of amusement in any structure, room or place in the State of Kansas which structure, room or place is capable of containing fifty or more persons unless the system of ventilation is capable of supplying at least 30 cu. ft. of fresh air per minute for each person therein.

VENTILATOR FANS—BOOTHS FOR PICTURE MACHINES—ELECTRIC WIRING

Sec. 5. All such structures, rooms or places used for the purpose mentioned in section 4 of this act having less than 500 cu. ft. of air space for each person, and all rooms having less than 2000 cu. ft. of air space for each person in which the outside window and door area used for ventilation is less than one-eighth of the floor area, shall be provided with a draught fan or other artificial means of ventilation installed so as to force the stagnant air outward from said structure, room or place. In the end of the room opposite said fan an inlet ventilator shall be provided of sufficient size to admit the required amount of fresh air as provided in section 4 of this act. All booths used for moving picture machines shall be made of galvanized sheet iron of not less than 20 B. W. gage, or ¼-in. hard asbestos board, securely riveted or bolted to angle iron frame (of not less than 1x1x¼ in. angle iron, properly braced), or equivalent fire resisting material. A not less than 6-in. diameter ventilating pipe shall be used as an exhaust for the hot air generated in operating the machine. All electric wiring shall be in accordance with the National Electrical Code.

Inspection is to be made at least once every six months, and failure to comply with the law makes the proprietor, lessee or manager subject to a fine of $10.00 per day for such failure.

State Superintendent of Building Inspection W. L. A. Johnson is sending out copies of the new law, which provides that 30 cu. ft. of fresh air per minute must be furnished for each person in the building. Accompanying the law is a set of rules devised by the State Superintendent to assist those concerned in fulfilling the requirements of the law. The rules are as follows:

"1. With natural ventilation by doors and windows, under normal conditions and at normal temperature, the velocity of air travel is estimated to be from 30 to 60 ft. per minute, where the exhaust equals the intake in area.

"2. With natural ventilation by ventilating flues and chimneys under normal conditions, the velocity of air travel is estimated at 200 to 300 ft. per minute. The velocity of air travel through ventilators in ceilings will range about 100 to 150 ft. per minute.

"3. Small power fans, placed in windows or openings in walls, will give a force velocity of air travel from 800 to 900 ft. per minute, where the fans compare reasonably well with the size of the openings.

"4. The velocity in number of feet of air travel per minute multiplied by the number of square feet of area of openings used for ventilation will give the volume of air in cubic feet that will pass through the opening per minute.

"5. To determine the required amount of artificial ventilation, multiply the number of seating capacity by thirty and from this amount subtract the number of cubic feet of air obtained per minute from natural ventilation as per rules 1 and 2. The remainder will be the amount of air in cubic feet to be supplied by fans or otherwise."

One of the things cautioned against in ventilating is the "short circuiting" of air.

"Baffle" boards for the breakage of drafts also are demanded by the law.

For correct ventilation, the inlet openings should be near the top of the room and the outlet near the bottom, and in the opposite end of the room. No intake should be placed less than 8 ft. about the floor. Where fans are used, it is recommended that they should all be placed in the outlet, so as to draw the foul air from the room.

The placing of chairs or stools in aisles also is to be tabooed under the new law.

A semi-annual report is required of the fire chief, whose duty it is to inspect the buildings to compel whatever change he may desire made.

Indiana Passes Ventilation Law

A satisfactory ventilation law has been passed in Indiana and was approved March 3, 1911, covering the ventilation of school houses. The law is entitled "An Act to protect the health and lives of school children and increase their efficiency by providing healthful school houses and requiring the teaching of hygiene." The subjects covered include sites, lighting, blackboards and cloakrooms, water supply and drinking arrangements, heating and ventilating, water closets and outhouses. The section on heating and ventilating is as follows:

"Ventilating heating stoves, furnaces and heaters of all kinds shall be capable of maintaining a temperature of 70° F. in zero weather and of maintaining a relative humidity of at least 40%; and said heaters of all kinds shall take air from outside the building and, after heating, introduce it into the schoolroom at a point not less than 5 nor more than 7 ft. from the floor, at a minimum rate of 30 cu. ft. per minute per pupil, regardless of outside atmospheric conditions; provided, that when direct-indirect steam heating is adopted this provision as to height of entrance of hot air shall not apply. Halls, office rooms, laboratories and manual training rooms may have direct steam radiators, but direct steam heating is forbidden for study schoolrooms, and direct-indirect steam heating is permitted.

"All schoolrooms shall be provided with ventilating ducts of ample size to withdraw the air at least four times every hour, and said ducts and their openings shall be on the same side of the room with the hot air ducts."

New Factory Ventilation Bill in New York State

A new bill has been introduced in the New York State Assembly by Mr. Boylan, to regulate the ventilation of factories and workrooms in the State of New York. It is No. 1480. This is a measure for which a committee of the American Society of Heating and Ventilating Engineers (D. D. Kimball, chairman) has been working on for over a year. While the committee reports that the proposed legislation is not everything that it could wish for, it is believed to be the best possible at this time, all things considered, and the bill is reported to have a good chance of passage, as it has the approval of a considerable number of associations, including those of realty interests.

The bill provides that a workroom must be ventilated so that the air within does not contain more than nine parts of carbon dioxide in 10,000 volumes of the air in excess of the number of parts of carbon dioxide in 10,000 volumes of the outside air, or so that there is constantly supplied throughout the interior of the room at least 1200 cu. ft. of air per hour per person, and, in addition, 1000 cu. ft. of air for each cubic foot of gas burned per hour, the air to be taken from an uncontaminated source. The temperature must never be less than 55° F., and, except in boiler-rooms, never more than 72° F. wet-bulb temperature, unless the wet-bulb temperature outside exceeds 70°, when the wet-bulb temperature inside must not exceed the wet-bulb temperature outside by more than 5.

The means for ventilation must be provided for by the owner unless a written agreement can be shown that the occupier is to furnish the means. The occupier must maintain the ventilation. Failure to provide the means of ventilation within 30 days of notice is penalized by a forfeit of $10 per day, and an occupier who fails to maintain ventilation is guilty of a misdemeanor. Local ventilation is required for special manufacturing processes where dust, fumes, gases and the like are given off. The Commissioner of Labor, under whose jurisdiction the operation of factories comes, is required to have an experienced engineer in the bureau of factory inspection to approve or disapprove plans for ventilation.

Federal Furnace League

Federal Furnace League, at its fourth annual meeting, held in New York, May 9, elected the following officers for the ensuing year:

President, Charles S. Prizer, Philadelphia; vice-president, A. W. Glessner, Chicago; executive committee: William J. Myers, New York; William C. J. Doolittle, Utica, N. Y.; Lewis Moore, Utica, N. Y.; George A. Munson, Connellsville, Pa., and Robert S. Wood, Troy, N. Y.

Mr. Prizer declined reëlection as president and the matter was left in the hands of the executive committee.

Among the subjects discussed were the following: "The Official Federal Furnace League Method of Testing Furnaces," by Dr. William F. Colbert, engineer and lecturer of the league; "Furnace Heating as the Only Practical Method of Indirect Heating," by George F. Langenburg, St. Louis.

A paper was also presented by W. W. Macon, secretary of The American Society of Heating and Ventilating Engineers.

American Radiator Co., Chicago, Ill., has sold its Bundy trap business to the Nashua Machine Co., Nashua, N. H., the new arrangement becoming effective May 1.

National District Heating Association

Arrangements are practically complete for the third annual convention of the National District Heating Association, which will be held at the Fort Pitt Hotel, Pittsburg, Tuesday, Wednesday and Thursday, June 6-8, 1911. The professional programme is substantially as follows:

TUESDAY AFTERNOON, JUNE 6

President's Address.

Report of Committee on Data. E. J. Kiefer, Easton, Pa., chairman.

WEDNESDAY MORNING, JUNE 7

Paper: "Investigation on the Transmission of Heat through Radiating Surfaces," by John R. Allen, Professor of Mechanical Engineering, Michigan University, Ann Arbor, Mich.

Paper: "Heating Franchises," by A. C. Gillham, Chicago, Ill.

Paper: "Result of Measuring Station Load by Venturi and General Electric Meters," by F. C. Chambers, Springfield, Ill.

THURSDAY MORNING, JUNE 8

Consideration and vote on new constitution.

Election of officers.

Paper: "The Heating and Ventilating Equipment of the City Investing Building of New York City," by J. Byers Holbrook, M.E., New York.

Report of the Committee on Meters.

Paper: "Superheated Steam," by W. E. Dowd, Philadelphia, Pa.

THURSDAY AFTERNOON, JUNE 8

Paper: "Handling Customers," by Geo. W. Wright, Baltimore, Md.

Report of Committee on Radiation.

Paper: "The Preparation of a Rational Rate System," by R. D. DeWolf, Rochester, N. Y.

Paper: "Best System of Radiation for Economy and Steam Consumption When Fed from a District Heating Station," by Walter J. Kline, Rockport, N. Y.

Same, as applied to hot water, by A. C. Rogers, Toledo, O.

Among the entertainment features will be an inspection trip to the works of the Westinghouse Electric & Manufacturing Co. in East Pittsburg.

Tuesday evening, June 6, the association will entertain all in attendance at a theater party at one of the theaters of Pittsburg. Announcement of this particular event will be made later.

On Wednesday afternoon, June 7, on the special invitation of the Westinghouse Electric and Manufacturing Company, Pittsburg, all attending will be taken as their guests to the great works of the Westinghouse Company, at East Pittsburg. The management of the Westinghouse Company is noted for its hospitality, and the afternoon can be looked forward to as one of the pleasures of the convention.

The entertainment committee for the convention is composed entirely of Pittsburg men, as follows:

Geo. W. [illegible], Manager, H. W. Johns-Manville Co.

R. S. Orr, General Superintendent, Allegheny County Light Co.

J. M. Graves, Superintendent, Power, Allegheny County Light Co.

W. A. [illegible], Superintendent, Contract Department, Allegheny County Light Co.

C. P. Hill, President, Doubleday Hill Electric Co.

W. D. Shaler, Secretary, Doubleday Hill Electric Co.

Cadwallader Evans, Jr., Superintendent, Oliver Power and Heating Co.

John H[illegible], Superintendent, Phipps Power Building.

H. C. Glass, Industrial and Power Department, Westinghouse Co.

J. C. McQuiston, Manager, Bureau of Publicity, Westinghouse Co.

J. O. Little, Assistant Manager, Bureau of Publicity, Westinghouse Co.

W. B. Wilkinson, Sales Department, Westinghouse Co.

J. D. Hiles, General Sales Manager, Best Manufacturing Co.

G. W. Provost, President, Union Electric Co.

John Klingelhofer, American Foundry and Construction Co.

E. B. Tyler, Pittsburg, Pa.

Ray [illegible], Manager, [illegible] Co.

The convention will open with the address of Mr. Geo. W. Wright, of Baltimore, Md., president of the association. Following this will be addresses by the mayor of Pittsburg, and the president of the Chamber of Commerce, welcoming the delegates to Pittsburg.

The report of the Committee on Data, which will be given by E. J. Keifer, will prove exceedingly interesting to all who are concerned in the cost of heating, as particular attention has been paid by the committee, in collecting the data, in reference to cost.

The University of Michigan, through its engineering department, has for some three years past been experimenting on the transmission of heat through different radiating surfaces and also the transmission of heat as affected by the coloring and painting of radiators, and the association is promised some interesting results of these experiments, which should result in a large saving to the central station as well as a saving to the user of radiators where he is furnishing his own fuel.

Franchises in the heating business are not difficult to procure, but central station men have found more trouble resulting from failure to include all things that should be included in such franchises, and this will be particularly considered by A. C. Gillham, of the Central Station Engineering Co., Chicago.

Users of meters are always inclined to look with suspicion upon the claims made by manufacturers of a particular meter, and an account of their reports and results where tabulated and obtained from actual use by central station men

that are not interested in the manufacture is always carefully considered and given much weight. The paper on this subject, which will describe the results which have been obtained from the use of two standard types of meters, will be presented by F. C. Chambers, of the Springfield Light, Heat and Power Company, Springfield, Ill.

The paper by J. Byers Holbrook, M.E., New York, will be a description of one of the latest installations of a great heating system—the plant installed in the City Investing Building, New York. This paper will prove of value to all interested in the installation of heating apparatus, whether of central station or isolated nature.

The subject of superheated steam is one which has been discussed pro and con by many central station men, and the paper of W. E. Dowd, Jr., manager of the Power Specialty Co., Philadelphia, promises some new development in that direction.

The paper by the president of the association, on the subject of handling customers, will prove of great value to the central station men, for probably in no other line of central station work has the subject of handling customers more weight than in central station heating work, as the question of comfort enters into the business greater than in any other line of plant operation.

A paper which is being looked forward to by central station heating men all over the country is on "The Preparation of a Rational Rate System," by R. D. DeWolf, of the Rochester Railway and Light Co., Rochester, N. Y. Heat is being sold all over this country in all kinds of manner, and the qualifications of Mr. DeWolf insure a paper upon this subject that will prove of great value.

At the request of a number of the members of the association, papers were solicited on the subject of the best systems of radiation and the best manner of installation of radiation system for connecting up to the central station mains. Considerable difficulty has been experienced by every central station man in connecting up systems of radiation which have been installed for isolated plants, and it is thought by the consideration of this subject to encourage the installation of such systems that will be easily adapted to and give the best results to central station mains. This will be considered from both the steam and hot water standpoint, the steam being treated in a paper by Walter J. Kline, of the American District Steam Co., of Lockport, N. Y., and for hot water by A. C. Rogers, manager of the heating department of the Toledo Railway and Light Co., Toledo, Ohio.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Advantages of Society's New Home

In a recently-issued circular, the advantages to the American Society of Heating and Ventilating Engineers, through its new location in the Engineering Societies Building, New York, are detailed at length. This body, it is pointed out, is now one of the associated engineering societies. By virtue of this connection, members of the society are privileged to consult the library at any time, as well as to use a writing and reception room adjoining the entrance hall. A reception and retiring room is also provided for the ladies. The society's own quarters are adapted for committee and other meetings relating to its work.

The circular contains illustrations from photographs of the principal rooms in the Engineering Societies Building, and concludes with a concise account of the society's activities and advantages of membership.

Illinois Chapter

The April meeting of the Illinois Chapter of the society was the occasion of a tribute of friendship and respect to John F. Hale, retiring secretary of the chapter, whose headquarters for the future will be in Camden, N. J., with Warren Webster & Co. Mr. Hale was presented with a silver water pitcher and following the more formal presentation he was made the recipient of the good wishes of the entire company. Samuel R. Lewis burst into poetry with a notable contribution, entitled "To John Hale." The office of secretary of the Illinois Chapter was filled by the election of Charles F. Newport.

An illustrated lecture was given during the evening by E. F. Capron on the "Panama Canal," detailing his recent trip to the Isthmus.

The resignation was announced of George D. Mehring from the local Ventilation Committee. August Kehm, the chapter's treasurer, announced that he had no report to make, as he was going to Europe, a statement that unintentionally evoked much hilarity.

"A Study of the Ventilation of Sleeping Cars" is the title of a paper by Thomas F. Crowder, M.D., read before the American Public Health Association, at its meeting in Milwaukee, in September, 1910. The paper is being reprinted for free distribution in pamphlet form by the Pullman Co., Chicago, Department of Sanitation, of which Mr. Crowder is superintendent.

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Pennsylvania State Association

The annual convention of the Pennsylvania State Association of Master Steam and Hot Water Fitters will be held in Pittsburg, Pa., May 27, with headquarters at the Fort Pitt Hotel, Penn avenue and 10th street. Following the convention it is planned to proceed in a body to the convention of the National Association in Chicago, which opens on the following Monday. The State Association is sending out a circular letter to its members asking for detailed lists of kits of tools entrusted to steamfitters and for information relating to the forms used by workmen reporting their time and material, both for contract work and jobbing work. The association is endeavoring to secure a greater uniformity in these respects and in similar details of shop management and the replies received will provide discussion not only at the State convention, but at the National convention.

Steam Heating and Ventilating Engineers of Chicago

At the second annual meeting of the Steam Heating and Ventilating Engigineers of Chicago, the following officers were elected: President, W. B. Graves; vice-president, John O'Shea; treasurer, William Sullivan; secretary, George H. Kirk; directors, Robert Gordon, Charles Glennon and G. F. Schample.

Current Heating and Ventilating Literature

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

CHURCHES

The Heating and Ventilation of Churches. Charles L. Hubbard. First of a series of articles prepared with special reference to the needs of the architect. Aims to give simple rules and directions for the selection of the heating and ventilating system, so that it may be incorporated in the plans. 3500 words. Br Build. Feb., 1911. 60c.

CHARTS FOR SOLVING FORMULAS

A Chart for the Calculation of Engineering Formulæ. M. E. J. Gheury. Describes principal charts for three or more variables involving curves, which may be constructed with great rapidity. 4,200 words. Engr. Feb. 24, 1911. 40c.

ECONOMIZERS

Notes on the Working of Economizers. 2000 words. Prac Engr. Mar. 17, 1911. 40c.

FAN BLAST HEATING

Design of Fan Blast Heating. H. C. Russell. Gives basic data covering the proportioning of heating apparatus for factories, schools and public buildings. 1800 words. Met. Wkr. Feb. 25, 1911. 20c.

Fan Drives and Pipe Sizes in Blast Heating. H. C. Russell. Gives hints on means of propelling blowers; formulas for steam and return pipes, etc. Discusses methods of humidifying air. 1200 words. Met. Wkr. Mar. 25, 1911. 20c.

HOT WATER HEATING

Details of Power Plant Design. Charles L. Hubbard. Deals with boiler piping and condenser equipment. 2000 words. Prac. Engr. Mar., 1911. 20c.

ISOLATED PLANTS

Central Station vs. Factory Plant. Henry D. Jackson. Gives two instances where cost of operation of isolated plants was less than the cost of Central Station service. 1500 words. Power. Feb. 14, 1911. 20c.

PIPING

Power Plant Piping. W. H. Wakeman. Describes various forms of supports for main steam pipes. 1300 words. Steam. May, 1911. LX. 20c.

POWER PLANTS

The New York Central Power Plant at West Albany. Illustrated description of the plant for furnishing light, heat, and power to the large repair shops, which has recently been enlarged. 2500 words. Eng. Rec. Feb. 18, 1911. 20c.

Congressional Power Plant at Washington. M. C. Turpin. Illustrated description of a central generating station for supplying a group of buildings on Capitol Hill with electricity and steam. 6000 words. Elec. Wld. Feb. 9, 1911. 20c.

TEMPERATURE REGULATION

Automatic Regulation of Temperature. Describes system in which the regulation of the temperature of rooms is automatically effected by means of a thermostat connected to a supply of compressed air at a pressure of 10 lbs. per sq. in., which is caused to act upon a simple diaphragm valve on the steam pipe to the radiators. 900 words. Engr. Mar. 3, 1911. 40c.

VENTILATION

Winter Uses for Electric Fans. Albert Scheible. Suggests their use to prevent air stagnation in rooms, diffusing the heat, restoring humidity, etc. 1500 words.

A New Vacuum Cleaning Plant for Residences

Almost everyone is now ready to admit the superiority of vacuum cleaning over any other system for the removal of dust, dirt and disease germs from carpets, upholsteries, tapestries, etc. As vacuum cleaning in the household has become more popular, and its advantages better understood, there has been an increasing demand for some kind of a stationary vacuum cleaning unit to take the place of the portable machine.

This demand is felt more keenly in the medium and large-size residences, where it is something of a job to lug around the ordinary types of portable cleaner. Therefore, the central vacuum cleaning system has been developed, in which the pump and a motor to drive it are located in the basement and the house is piped in a manner similar to the ordinary steam piping, and outlets are provided on different floors at convenient places for attaching the length of hose and the cleaning tool. The advantage of this system is that all of the dust collecting apparatus can be located in the basement in an out-of-the-way place; there is no danger of the dirt getting out of the dust receptacle and back into the room, and it is entirely unnecessary to handle the dirt after it has once been collected.

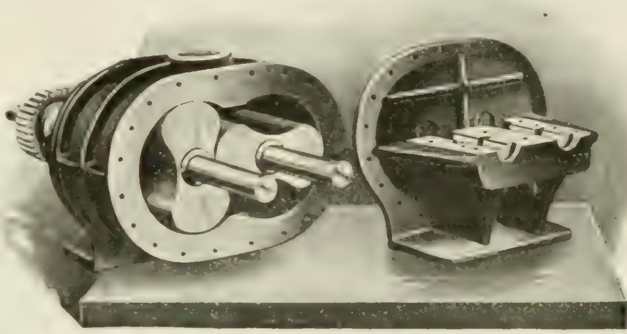


FIG. 2—CONNERSVILLE ROTARY PUMP WITH END COVER REMOVED

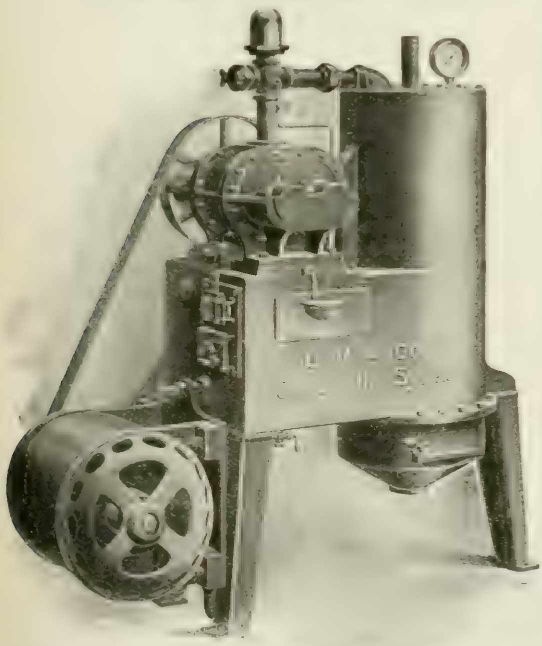


FIG. 1—HOUSE VACUUM CLEANING UNIT

However, most of these central vacuum cleaning systems have merely been large-size, portable machines located in the basement. The United Vacuum Appliance Company, New York and Connersville, Ind., has recently brought out a different system in which the vacuum producing part consists of a rotary blower of the Connersville type. This type of blower has been in use for many years for pumping gases and for removing the air from condensers, etc.

As will be noted from Fig. 1, the Connersville residential outfit consists of a motor, a vacuum pump and a separator tank, all compactly grouped on one base. The air and dirt from the piping system enters the top of the tank, pass through a pipe which is immersed in water, allowing the air to filter through, but catching all the dirt and holding it in suspension. The dirty water is discharged automatically into the sewer immediately after stopping the motor, leaving the separator empty and ready for the next cleaning. When the motor is started again, the separator tank receives its supply of water automatically, requiring for each filling about six or eight gallons. By the use of this device the pump receives only clean air, which overcomes the wear and tear due to foreign matter passing through it. The exhaust air is then carried to the chimney or other vent. If desired, the sewer and water connection can be dispensed with, substituting for them a canvas screen separator and catching the dirt in a galvanized iron receiver, which is emptied by the operator.

The pump used in this unit is shown with end cover removed, in Fig. 2, from which it will be seen that it consists only

of a shell and two revolving impellers. There are no valves to become clogged. The bearings are made extra large and provided with oil wells and ring oilers so that the only attention that the pump needs is an occasional replenishing of the oil reservoirs.

The motor is mounted vertically on a hinged frame so that the belt can be tightened or loosened by the set screw. The starting mechanism is grouped on the vacuum cleaning unit so that there is practically no wiring expense incurred in installing this unit. The Connersville pump has been found to be noiseless in operation.

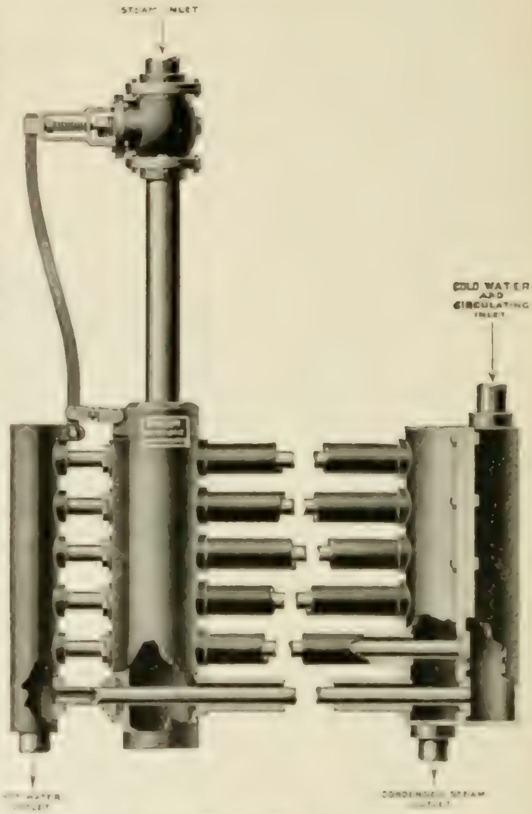
Buffalo Strainers

For removing foreign matter from feed water, water supply and similar systems, a strainer that differs in many ways from the usual type has recently been placed on the market. The development of strainers has been along the line of automatic and semi-automatic types, involving more or less complicated design. The feature of this new strainer is in the opposite direction. It consists of only four parts,—the body, basket, top and clamp. To clean the strainer it is necessary simply to loosen and remove clamp and cover, take out basket and clean under a faucet.

The vital part of every strainer, the basket, is of fine mesh brass screen, soldered to a brass "former" or top piece, and stiffened both horizontally and vertically by brass strips and bands. It is made unusually large to decrease the resistance offered to the flow of water, the minimum area allowed being fifteen times that of the connecting pipe. This also increases the effectiveness of the strainer and lengthens the time in service before cleaning becomes necessary. If continuous operation is necessary, a by-pass, with or without a second strainer, can be installed.

The service given for many years by these strainers in connection with air washing apparatus made by the Buffalo Forge Co., Buffalo, N. Y., has induced this company to place the strainer on the market for general service. A new booklet, No. 114, describes this strainer in detail.

BUFFALO WATER STRAINER



SIX-PIPE MADSEN WATER HEATER, WITH A CAPACITY OF [illegible] GALS OF WATER PER HOUR FROM [illegible] TO [illegible] F. USING STEAM AT 5 LBS GAGE

Madsen Automatic Water Heater

A continuous supply of hot water at the desired temperature, the elimination of storage tanks, positive and automatic action, cleanliness, economy, no floor space required and provision for increase of capacity are among the more important features noted in the construction of the Madsen Automatic Water Heater, made by the Spacesaving Appliance Co., 135-141 West 20th street, New York. This interesting heater consists of a group of concentric iron and brass pipes, water passing through the inner pipes and steam through the outer. The steam and water do not come in contact, a feature designed to keep the water pure.

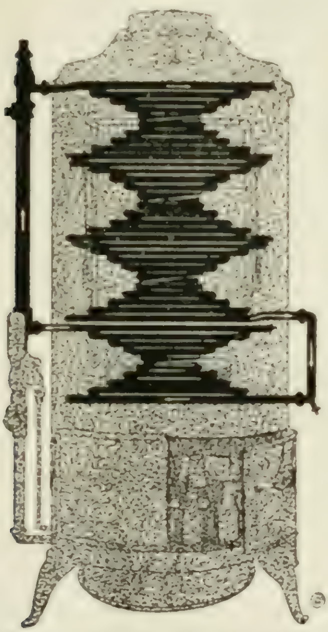
To maintain the hot water at a fixed temperature, with a variable demand, steam is admitted to the heater through an automatic valve, which can be set to give water of any desired temperature. The steam valve is operated by a lever, controlled by the

inner brass pipes, which contract and expand as the water is drawn from the heater.

The heater is made in five sizes for low pressure steam using ¾-in. brass pipe and has a capacity of supplying from 85 gals. of water per hour at atmospheric pressure to 1176 gals. per hour at 4-lbs. pressure. For high pressure, it is made with both ½-in. and ¾-in. brass pipes, with a capacity from 120 gals. of water per hour at 5-lbs. pressure to 6000 gals. per hour at 75-lbs. pressure.

Overcoming Lime Deposits in Water Heaters

This fault has been successfully overcome in the type known as the Pittsburg heaters, manufactured by the Pittsburg Water Heater Co., Pittsburg, Pa. The



PITTSBURG WATER HEATER EQUIPPED WITH CIRCULATING THERMOSTAT

circulating thermostat causes a continual circulation of water through the extra large coils, preventing overheating and eliminating all chance of deposits forming and at the same time keeping the water at uniform heat. Accurate regulation and control of the heat of the water prevents precipitation, as hard water will not precipitate except when heated to 150° F. or over. The thermostat is set to shut off the gas at 140° F.

Vacuum Heating System (Air Exhauster) is the title of a circular published by Frederick Leonhard, Cleveland, O., illustrating and describing the Leonhard automatic water-driven air exhauster for use in connection with vacuum steam heating systems.

Economical Power Plant Operation is the subject of an interesting treatise published by the Department of Testing and Inspection of the Richard D. Kimball Co., engineers, Boston and New York. The book is designed to show heating, lighting and power plant owners, managers and superintendents, the various ways in which wastes occur in the operation of such plants and outlines a method of testing and regular inspection to obtain the most economical and efficient operation. Pp. 24. Size 5½x8½ in.

Advertisers' Index

TRADE AND MISCELLANEOUS NOTES

Coming Events

June 6-8, 1911. Third annual convention of the National District Heating Association at Pittsburg, Pa. Headquarters will be at the Fort Pitt Hotel.

June 13-15, 1911. Annual convention of the National Association of Master Plumbers, Galveston, Texas. Headquarters at the Tremont Hotel.

June 27-30, 1911. Semi-annual (midsummer) meeting of The American Society of Heating and Ventilating Engineers on Lake Michigan. Members and guests assemble at Chicago, June 27, and embark on lake steamer "Carolina."

Deaths

A. T. Hoyt, a heating engineer of Warren, O., died March 19. He was 65 years old. Mr. Hoyt was known to members of the American Society of Heating and Ventilating Engineers through a paper he presented at the Detroit meeting in 1904, in which he described what he termed a vacuum hot-water heating system for a greenhouse.

George W. Fels, president of the Economy Gas Heater Co., Cincinnati, O., died at his home in that city March 30. He was 61 years old. He is succeeded bv his son, Clifford Fels.

Capt. A. C. Ford, managing director of the Citizens' Mutual Heating Co., Terre Haute, Ind., died at his home in that city March 30. He was 72 years old. He is succeeded by Henry Meyer, president of the Terre Haute Pure Milk Co.

Ludwig Wolff, president of the L. Wolff Mfg. Co., Chicago, died at his home in Chicago, April 14, in his 76th year. He is survived by five sons and one daughter.

Manufacturers' Notes

Pierce, Butler & Pierce Mfg. Co., Syracuse, N. Y., has opened a branch office in

Cincinnati, in the Fourth National Bank Building. William Grier is in charge.

Consolidated Engineering Co., Chicago, Ill., announces the election as vice-president of Edward B. Gordon, to succeed John F. Hale, who has become associated with Warren Webster & Co., at Camden, N. J.

Junkins Bros., 80 White street, New York, will hereafter act as sales agents for the complete line of steam heating specialties heretofore sold by the Positive Differential System Co., New York.

United States Radiator Corporation announces the removal of its general offices from Dunkirk to Detroit, by special train, April 19. The new offices in Detroit will be located in the Dodge Building, Jefferson avenue and Brush street. These offices will be only temporary, being used until such time as the new building is completed in which the company's permanent offices will be located. The advantages of a location in Detroit will enable the corporation to handle its business more quickly and accurately.

National Radiator Co., Johnstown, Pa., is completing improvements and extensions to its recently?purchased plant at Trenton, N. J., and the plant is expected to be ready for operation by the middle of June. Charles N. Tull will be in charge.

American Radiator Co., Chicago, it is said, has purchased a tract of land in Bayonne, N. J., at Forty-ninth street, between the tracks of the Lehigh Valley Railroad and New York Bay, on which, it is further rumored, it will build a plant that will enable the company to manufacture its product at tidewater.

Fire Retaining Heating Co., Dayton, O., recently incorporated to manufacture furnaces and other heating apparatus, announces an increase in its capital stock from $5,000 to $500,000.

Joseph Dixon Crucible Co., Jersey City, N. J., announces the appointment of Sherman Paris in its advertising department, succeeding H. S. Snyder.

Central Foundry Co., New York, which has been for some time in the hands of a receiver, has been sold by Receiver Waddill Catchings, on order of the court, to Frederick H. Buss and Daniel A. Hohmann, for $1,659,500. This includes all its properties and interests, excepting the Central Radiator Co. The unsecured claims against the company amounted to $4,222,000.

Continental Radiator and Foundry Co., St. Louis, Mo., is planning to build a new foundry for the purpose of manufacturing cast iron radiators on a scale of from 3,000,000 to 4,000,000 sq. ft. a year. The new building and equipment is estimated

to cost $75,000. The company's present foundry is located at South St. Louis.

Illinois Blower Co., Chicago, has opened quarters at 119 West 35th street, and will engage in heating and ventilating engineering, with special reference to blower installations. W. B. Crawford, for several years with the Garden City Fan Co., is manager.

Sloan Valve Co., Chicago, has increased its capital stock from $30,000 to $75,000.

Kelly & Jones Co., Pittsburg, Pa., is building a new plant at Greensburg, Pa., to cost $80,000, which will materially increase its capacity for the manufacture of pipe, valves and fittings. The new building will be 395 ft. long by 62 ft. in width, and will contain 98,600 sq. ft. of floor space.

C. A. Dunham Co., Marshalltown, Ia., manufacturers of the Dunham system of vacuum steam heating, has purchased the holdings of the National Vacuum Heating Co., which was the sales agent for the Dunham Company. The two companies have always been closely associated.

Jenkins Bros., New York, the well-known manufacturers of valves and packings, announce their removal to new quarters at 80 White street, between Broadway and Lafayette street. In a special announcement notifving the trade of the change, the company states that "after doing business for 30 years in one place, we will, on April 17, 1911, move for one reason—that our business has entirely outgrown the accommodations afforded by the old building. 71 John street. While we cannot leave the old business home without a sentimental regret, we are looking forward with pleasure to the increased facilities afforded by the much larger building. 80 White street, where we will be ready to met our old friends with wonted pleasure and the wish and hope of enlarged business for them and ourselves by the increased facilities, together with a constant striving on our part to render a more perfect business service."

Pressed Radiator Co. of America, Pittsburg, Pa., announces the removal of its New York office to its old quarters in the Brunswick Building, 225 Fifth avenue.

Business Changes

Walker & Chambers, engineers and contractors for heating and ventilating, announce the removal of their offices to 222 East 41st street, where they have combined their office, steam fitting and sheet metal works.

James Smyth Plumbing and Heating Co., Spokane, Wash., has purchased a plot of ground at Post street and Second avenue for $80,000, on which it will erect a new building.

Miscellaneous Notes

Montpelier, Vt.—A drain has been put in from the air duct at the east end of the State House to the waste pipe near the street. The duct is a part of the new heating and ventilating system that was put in last winter, but which has frequently been found filled with water.

Syracuse, N. Y.—The plant, franchises, equipment and all real and personal property owned by the Municipal Heating Co., of Syracuse, covered by a mortgage that was made to protect a bond issue of $300,000 in January, 1902, were sold under mortgage foreclosure proceedings April 25, to Ernest I. White. Mr. White's bid was $5,000. It is said that tentative plans have been made for the organization of a new company to take over the plant. The Municipal Heating Company has done no business in the last year. The company tried to obtain a lighting franchise and when it failed in this, it closed its heating contracts and has been idle since June of last year.

Milwaukee, Wis.—That city factory inspectors may legally be refused admission to the theatres while a performance is going on and that such places of entertainment cannot rightfully be classed as "working places" was the opinion of Judge Neele B. Neelen, in District Court, recently when the case against James A. Higler, manager of the Majestic Theatre, came up. Two factory inspectors alleged that when sent to the theatre on March 6 by the health inspector to look for persons violating the spitting ordinance and to inspect the ventilators, they were refused admittance. The case was dismissed.

Citizens' Mutual Heating Co., Terre Haute, Ind., will build a new power house 60 by 75 ft. to contain two 400 H. P. boilers and auxiliary apparatus.

Francis H. Wiswell, formerly of the International Heater Co., Utica, N. Y., has been elected vice-president of the Mohawk Valley Heating Co., of Utica.

R. J. Gross, president of the United States Radiator Corporation, has been spending some time in Porto Rico, with a party of friends.

Frederick W. Herendeen, associate sales manager of the United States Radiator Corporation, accompanied by Mrs. Herendeen, is on a trip to Los Angeles, Cal.

Modern Science Club, Brooklyn, N. Y., at its annual meeting, April 11, elected as president James A. Donnelly, president of the Positive Differential System Co., of New York.

St. Louis, Mo.—Undaunted by the failure of its bill providing for the proper heating and ventilating of the street cars passed at the last session of the Municipal Assembly, the Civic League will present another bill for the same object. The bill will specify heating devices that

will meet the tests required by the United Railways Company and the Board of Public Improvements.

New Incorporations

Warren Water Heater Co., Minneapolis, Minn., capital $25,000. President, P. G. Speakes; secretary, C. L. Ward.

New York Heater & Supply Co., Jersey City, N. J., capital $50,000. Incorporators: William H. Goff, Norman E. Wiggins and M. E. Duanne. The company is to engage as mechanical engineers, brass founders, boiler makers, etc.

Frank Miller Plumbing & Heating Co., Toledo, O., capital $100,000. Incorporators: Frank Miller and others.

West Chester Heating Co., West Chester, Pa., capital $5,000.

John F. Leary Co., Little Falls, N. Y., capital $25,000, to conduct heating and plumbing business. Incorporators: John F. Leary and Edward J. Walsh.

Eagan Bros. Co., Toledo, O., incorporated to take over business of Eagan Bros., heating and plumbing contractors. Incorporators: Michael R. Eagan, president; B. P. Lyon, vice-president; W. R. Hodge and Conrad Weil.

Thomas C. Rich Co., Omaha, Neb., capital $10,000, to conduct a heating and plumbing business.

International Automatic Valve & Supply Co., Chicago, capital $25,000.

Ohio Valley Brass & Iron Co., Wellsburg, W. Va., capital $75,000, to manufacture steam goods and plumbing specialties.

P. J. Flannery Co., New Britain, Conn., capital $50,000, to manufacture heating and plumbing specialties. Incorporators: Thomas F., Grace A., James F., Mary A., John H., William J. Flannery and Anna Flannery Ruep.

Sanitary Gas & Heating Co., Wilmington, Del., capital $125,000, to deal in water heaters and gas radiators. Incorporators: W. Taylor Birch, M. R. Rodgers and Stewart Ellis, all of Washington, D. C.

Washington Plumbing & Heating Co., Tacoma, Wash., capital $50,000. Incorporators: F. McHugh, William J. Purtell and Wesley Lloyd.

American Heat & Power Co., Oakland, Cal., capital $100,000. Incorporators: J. A. Craig and J. H. King, of Oakland, and J. H. Becker, of San Francisco.

Selman Plumbing & Heating Co., Birmingham, Ala., capital $15,000, to engage in contracting business and to deal in heating, plumbing and electrical specialties. Incorporators: J. A. Selman, William C. Lebo, Frank H. Potter and F. B. Carpenter.

Contracts Awarded

T. J. McQuellon, Peoria, Ill., heating and ventilating new Douglas School at that place for $8,832. The plumbing contract went to Dooley & Bruninga at $6,880.

L. Luderbach, Jackson, Miss., heating and electric work for the Mississippi Charity Hospital, at that place. The contract amounts to $16,000.

Hackney Ventilating Co., St. Paul, Minn., ventilating system for the First National Bank and Western Union Building, Duluth.

Tow, Defendorf & Bruff, Rochester, N. Y., heating and ventilating buildings at Exposition Park, Rochester. The contract amounts to $16,610.43.

Reliance Heating Co., Pittsburg, Pa., heating five-story Keenan Building at Grant and Sixth avenues; also heating new office building of the American Bridge Co.

Huey Bros., Boston, Mass., heating and ventilating Mary Lyon School Building, Boston, for $6,087.

Wittman, Lyman & Co., San Francisco, Cal., heating, plumbing in the six-story building for F. A. Daroux on Jones street, for $8,340.

Downey Heating & Supply Co., heating and ventilating new Twenty-second District School, No. 4, for $2,680.

Healy Heating & Plumbing Co., St. Paul, Minn., heating, ventilating, lighting and elevator installation in new laundry building at the city and county hospital, that city, for $6,195.

Allen, Myers & Co., Rock Island, Ill., steam heating, plumbing and gas fitting for the new Rock Island Savings Bank; also steam heating and plumbing for Central Presbyterian Church.

D. E. Burke, Pueblo, Col., heating and plumbing new Pueblo county court house for $48,000. A hot-blast heating system will be installed.

Buffalo Forge Co., Buffalo, N. Y., reports recent orders for mechanical draft apparatus from the Cambria Steel Company, Johnstown, Pa., American Smelting & Refining Co., New York; The Burgess Sulphite Fibre Co., Berlin, N. H.; Knickerbocker Portland Cement Co., Hudson, N. Y., and several export orders from its agents in Germany, Japan and South America. The company reports the export business as particularly active so far this year and with excellent prospects of exceeding that of any former season.

G. H. McLean Co., Springfield, Mass., heating plant equipment for the new $78,000 central station heating plant, which the city of Springfield is building for its municipal group of buildings.

Business Troubles

Thomas F. Cushing Co., 451-455 West 125th street, New York, dealers in pipe, filed a petition in bankruptcy April 19 last, with liabilities scheduled at $73,816 and nominal assets at $153,013. The company was incorporated in 1905 with a capital stock of $150,000. It is stated that the founder and president of the company, Thomas F. Cushing, is confined to his home, unable to attend to the business and that the company is without a managing head.

Home Heating Co., Anderson, Ind., has failed and Flavius Jackson has been appointed receiver on application of the Anderson Trust Co., which holds a $15,000 mortgage on the plant. The plant will be sold.

New Work

Columbus, O.—As the result of a report on the heating system of the Franklin county court house, made by a special committee of architects, composed of Fred W. Elliott and William H. Tremaine, an entirely new system of vacuum heating, with ventilation, will probably be installed. The work will amount to $8,000.

Peoria, Ill.—The trustees of Bradley Institute have engaged M. W. Whitmeyer as architect and C. O. Poppin as mechanical engineer, to design a new power plant for the institute, to cost $65,000. It will include a new heating and lighting system. The building will be 90 by 70 ft. and will be two stories high.

Salt Lake City, Utah.—The Board of County Commissioners is arranging for a new ventilating system for the county infirmary.

Manhattan, Kan.—A new heating plant will be installed at the State Hospital. The work is being designed by President Waters, of the Agricultural College; E. B. McCormick, dean of engineering, and L. E. Conrad, professor of civil engineering.

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following-named work: Until May 25, 1911, for the construction, including plumbing and ventilation, gas piping, heating apparatus, electric conduits and wiring of the United States Postoffice and Custom House at San Diego, Cal.

Trade Literature

Autoforce Ventilating System, Boston, Mass., has issued an interesting circular of fac simile testimonials received from

those using this method of automatic ventilation. A number of illustrations are added showing Autoforce ventilators in operation in various classes of buildings, including mills, hotels, and churches.

Cochrane Steam-Stack and Cut-Out Valve Feed Water Heater and Receiver and its operation is illustrated in an ingenious model now being distributed by the Harrison Safety Boiler Works, 3189 North 17th street, Philadelphia. The model, which is made of stiff celluloid, illustrates neatly the fact that when the heater is cut off from the exhaust steam supply the separator attached to and forming a part of the heater continues to furnish exhaust steam, purified of oil, to the heating or drying system, while the trap is cut off from communication with the heater, but still continues to drain the separator. Communication between the separator and the heater and between the trap and heater is controlled by two semi-rotary or Corliss valves. In the case of the steam value, the opening is quite large, and the valve when closed receives the pressure not only of springs, but also of the back pressure carried on the engine. Inasmuch as this pressure, multiplied by the large area, might create sufficient friction to render the opening difficult, the valve gear is so arranged that while both valves are opened from one handle, the small valve between the trap and the heater opens first, letting pressure from the exhaust line into the heater to balance the pressure on the steam valve, which is next opened by continuing the motion of the handle. In closing the valve, a similar process is carried out,—that is, the larger valve closes before the small valve has entirely cut off communication between the exhaust steam line and the interior of the heater. The proper timing of the motions is secured by correcting the cranks attached to the respective valves. The link, however, is slotted, permitting the smaller valve a certain excess of motion after the larger

valve has come to rest in closing and before it begins to move in opening. Upon the reverse of the model it is stated that full particulars regarding the application of these heaters in connection with all kinds of exhaust steam heating systems are fully explained in the "Exhaust Steam Heating Encyclopedia," published by the manufacturer, which, with the model, is sent gratis to persons who are interested in the design, installation or operation of exhaust steam heating systems, and who state the name of the concern with which they are connected and the use at present made of the exhaust steam.

United Vacuum Appliance Co., New York, has issued an attractive 32-page catalogue in which vacuum cleaning systems are exhaustively discussed. Some remarks are also included on the engineering features of air moving, including a discussion of the best methods of carrying dust by means of air and of producing a vacuum. The pamphlet points out the advantages of the Connersville valveless positive pressure blower for vacuum cleaning systems, and includes some test curves showing its power consumption as compared with other types of units. The tables on air velocity and pipe equalization, as well as other tables for converting units, will be of assistance to architects and engineers in laying out and specifying central vacuum cleaning systems.

THE HEATING AND VENTILATING MAGAZINE

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*Methods of Connecting Hot Water Heating Systems to a District Heating System**

By A. C. Rogers,

Toledo (O.) Railways and Light Co.

The subjects and business connected with a public service company have a peculiarity all their own, and in taking up this subject the relation between the public and the heating company, and the generally abnormal demands by the public of the public service company, will have its influence on the engineering department as well as on other branches. In the heating branch the consumer will ask for and expect results that if he were supplying himself would not be enjoyed nor figured for. This can be illustrated by citing the case of a heating system locally run in the consumer's building, and, so far as good results or economy are considered, never approached nor enjoyed, but if that same system is connected to a district heating company, a demurrer to any changing or any waiver of anticipated good will have to be forced from the consumer by a series of demonstrative talks, giving the whys and wherefores in a very lucid manner.

In the drawings the same reference letters are used to designate the same points:

A represents the heating company's service pipes into building.

B represents the house system feed main or flow pipe.

C represents the house system return main.

D represents the radiator supply and return branches.

E represents a valve or blank flange on boiler feed to flow main.

F represents the same on return pipe or main.

G represents the service valves on district supply service inside building wall.

H represents the heating company's regulating valve on return pipe of service.

J represents the connection of service flow into B.

K represents the connection of service return into C.

L represents drip or drain connections.

M represents regulating cock or valve on return branches.

N represents a small pipe by-pass in system Fig. 6.

O represents a disc or regulating cock by-pass in system Fig. 7.

P represents a by-pass of full pipe with radiator branches taken off with "y's" or branch tees.

R represents a secondary garage service.

S represents a by-pass with customary three valves to form it.

Before describing each plate or illustration, let me state that district hot-water heating is a forced feed and

*Read before the third annual convention of the National District Heating Association, in Pittsburg, June 6-8, 1911.

that the best results and greatest economy come from maintaining a gravity flow and outflow to all radiators. By reason of this forced feed all heating systems are very sensitive, some more than others, but, as a class, very much more than a regular gravity heating system. A trap is detrimental to gravity heating, and is fatal to that part when trapped on a pressure gravity system.

A general supervision of house installations when connected to district heating is incumbent upon the engineering department of the heating company. This holds good for hot water as well as steam heating, and is largely practiced by all companies. As regards new work, this presents a problem that may be easily accomplished, but when contemplating heating systems already installed and being locally heated the engineer may expect to meet difficulties both in the system and with the owner. An owner may be indifferent to results and economy when running his own heating plant and yet may be very exacting when getting service from a district heating company. The engineer often meets with systems that cause him to wonder how heating was ever thought of or accomplished.

In considering this subject, a valuable asset to the writer is the experience of connection with a district heating company and the results by the department with which he is detailed.

In Fig. 1 we illustrate a system that was used more some years ago than now, although when properly laid out and installed gives very good results. The feed of all radiators is taken off the top of the main and the return is put into the side of the main. In this system there is a gradual drop in temperature as the water flows along the main, due to the cooled water in the radiators dumping back into the main and the radiators must be figured for this drop to give the results desired. The method of adjusting for district heating in this case is as follows:

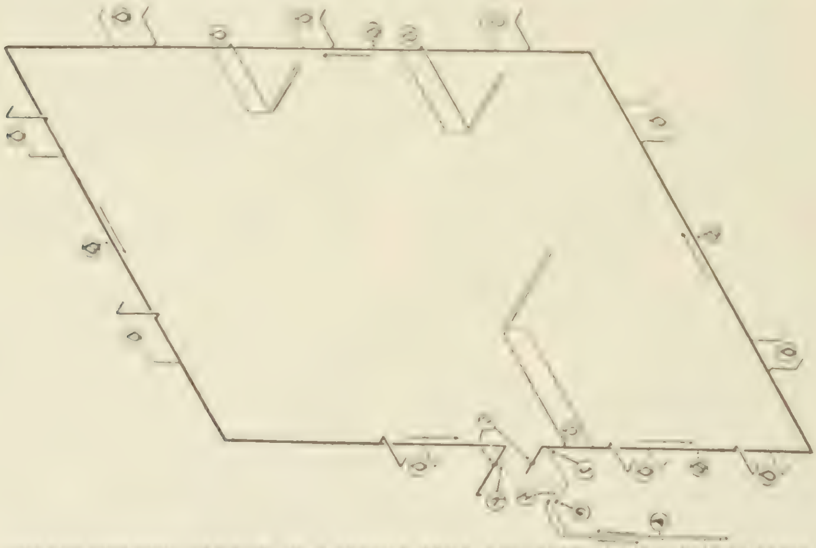


FIG. 1- DIAGRAMMATIC SKETCH OF A SINGLE BELT LINE PIPE SERIES UNDERFEED HOT WATER GRAVITY SYSTEM

The boiler is cut out by putting valves in the flow and return pipes or blank flanges or blind gaskets in flange unions, as at E F; the expansion tank is cut off by valve or by capping or plugging the leads to it; the service is cut in by tapping the main at J and K. Service valves G are always put on service inside building wall, and regulating valve H is placed on the service return pipe just before leaving the building; by proper adjustment of H the results are fully up to all that was ever accomplished by local heating, if not better.

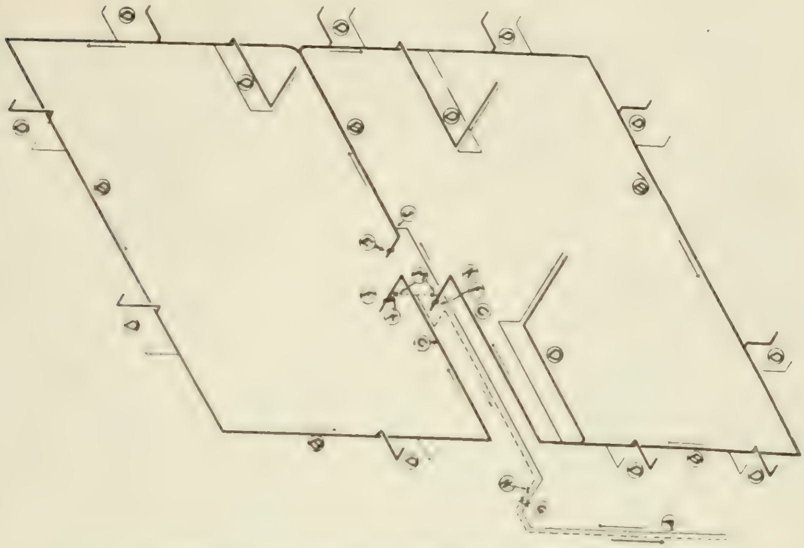


FIG. 2—TWO-BELT SYSTEM, SIMILAR TO FIG. 1

In Fig. 2 a system the same as Fig. 1 is illustrated, except the system has two belts and, in addition to the instructions for Fig. 1, the return has two connections, and regulating cocks M are installed on both returns and adjusted to equalize both belts, preventing a short circuit in either belt and giving an equal distribution.

Fig. 3 is an illustration of the well-known two-pipe underfeed gravity, and the following method is given: Blank off boiler at feed and return and also expansion tank; tap feed service in at boiler as at J, and tap return in extreme end of return main away from boiler as at K; this method prevents short circuiting and promotes a balancing that is otherwise troublesome.

Fig. 4 is an illustration of a single-belt, two-pipe, underfeed gravity, with parallel mains, but opposing flow. The writer would place this system at the head of all underfeed work. The mains of themselves will practically

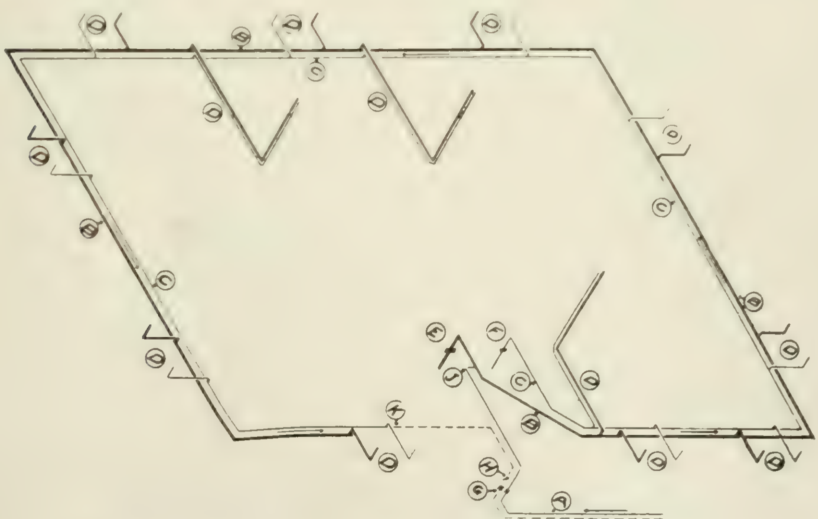


FIG. 3—ONE-BELT, TWO-PIPE, UNDERFEED GRAVITY SYSTEM, WITH PARALLEL MAINS

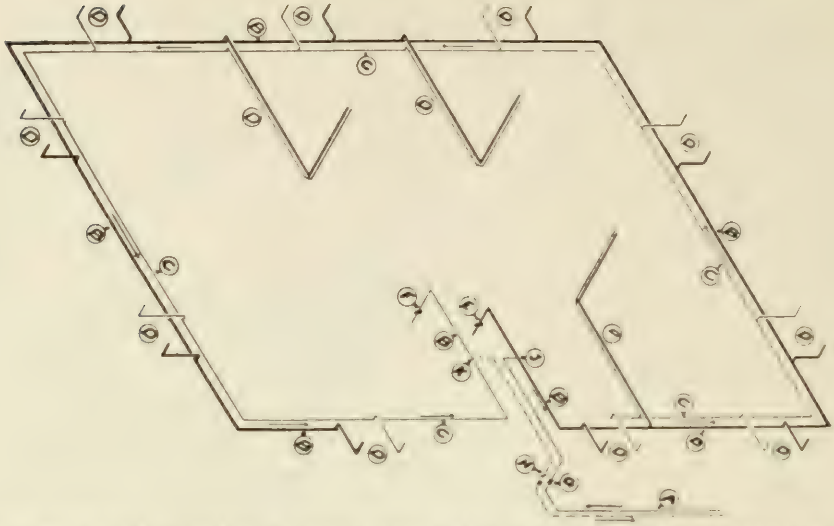


FIG. 4—ONE BELT, TWO PIPE, UNDERFEED GRAVITY SYSTEM, WITH PARALLEL BUT OPPOSED MAINS

make a balance to the job, and a building, even though quite large, with clearance for mains, can be accommodated on one belt. This job will work gravity, without pitch to mains, providing the size of mains is liberal. The method of connecting to district heating is readily outlined.

Fig. 5 is a sketch of only a portion of a multiple underfeed system, only the headers being shown. We meet this work sometimes and make the following for connecting: Tap main flow header at J and tap each return marked C at K, installing a cock M for regulation on each unit; the boiler is blanked off as before at E F; by adjusting M with opening in each to suit the duty, a balance is made and short circuiting prevented.

Fig. 6 is a one-pipe, forced-feed series system and for district work only, where at one time it was universal for district work; the sketch shows the pipe main carried along between the radiator branches, which is called a by-pass, and the sketch shows three different kinds—first, a small pipe by-pass N, the pipe being smaller than the main favors a flow through the radiator; next, a by-pass with cock for adjustment or a union with a disc with a hole of proper size (this is shown at O); and, next, a full by-pass as at P, with branches taken off with Y fittings or branch tees; there are some places such as shown in Fig. 11 where this system is the only way, but for house or residence work this system is not allowed any more.

Fig. 7 shows a forced-feed heating coil, such as for factory and garage work; the feed is connected to the bottom of coil and return is out the top; by this method a full pipe is assured and the coil is self-freeing of air, all air being driven out and no air vents being needed; the sketch shows a coil running along the wall with right-angled branch and a continuation through to another room; headers cannot be used in this work on account of short circuits and a return

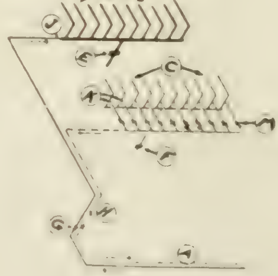


FIG. 5—HEADERS AT THE BOILERS OF A MULTIPLE UNDERFEED GRAVITY SYSTEM

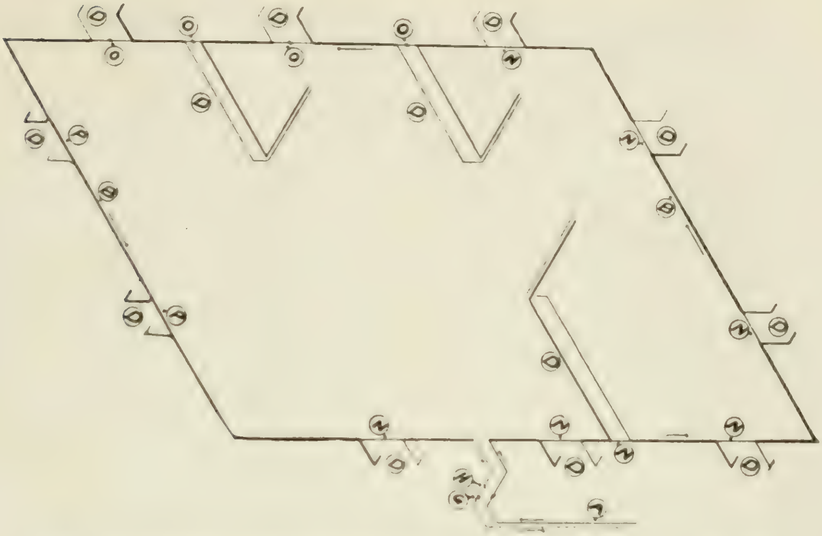
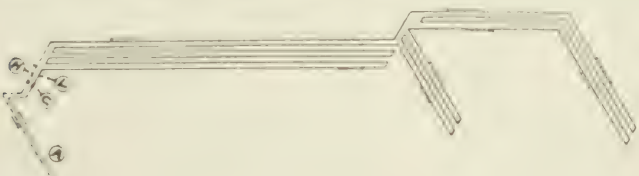


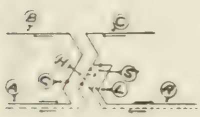
FIG. 6—ONE-BELT, SINGLE-PIPE SERIES, PRESSURE GRAVITY SYSTEM

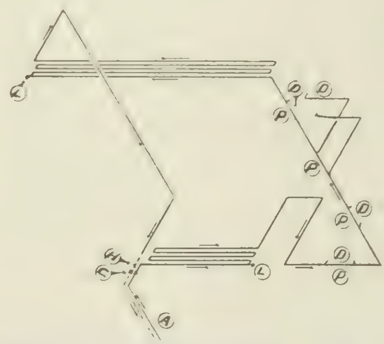
bend coil is used; where a header coil is met with, discs or cocks for regulation in each coil pipe are necessary.

Fig. 8 shows a method in use where a garage is supplied after heating the residence; the garage service is shown and marked R, the same being cut in the return pipe only, and for control a by-pass S with three valves is installed; by this method the garage is fed when wanted and otherwise cut out; when garage is on, regulator H is opened for larger feed and good results are found to be the case.

Fig. 9 shows the standard two-pipe pressure gravity system which is locally called "double belt" and is the system most generally used now; it gives perfect results, is low in friction and balances up with no drawbacks; it is very sensitive, though, and any trap in radiator branches is fatal to







FIGS. 7, 8 AND 11. FIG. 7 (at top) SERIES COIL PRESSURE HEATING SYSTEM. FIG. 8 (small cut at left) CONNECTION OF GARAGE SERVICE TO THE HOUSE SERVICE. FIG. 11 (at right) SINGLE SERIES, SINGLE PIPE PRESSURE OR FORCED FEED SYSTEM

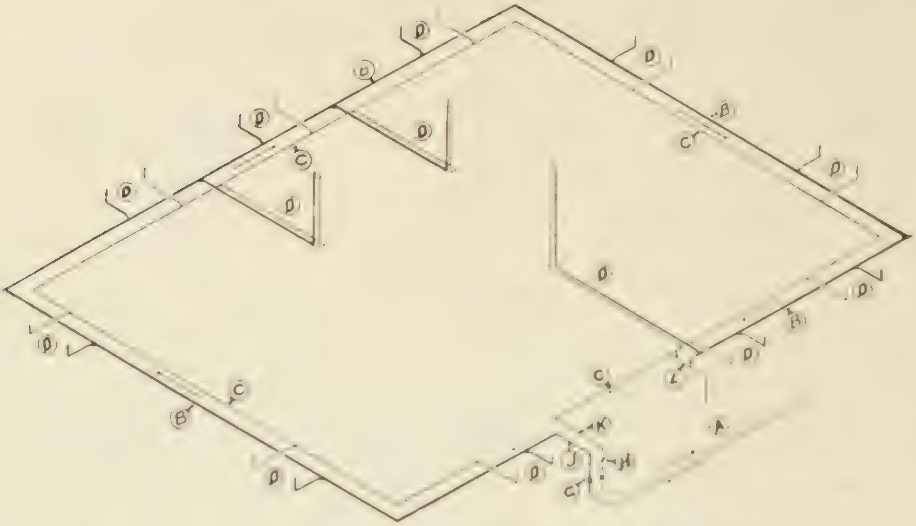


FIG. [illegible] ONE BELT TWO-PIPE UNDERFEED PRESSURE GRAVITY SYSTEM

that radiator. This belt on, say, 20 ft. by 30 ft., can supply 1200 sq. ft. of radiation on 1½-in. belt with ample results; larger belts are made in 2-in. and 2½-in. pipe sizes.

Fig. 10 shows the same system for locations where the radiators are located in a narrow zone; it is a three-pipe belt and gives results that are all that is expected; for double flat buildings this is specific.

Fig. 11 shows a system installed in a garage which is a series pipe job with radiators and coils both; a radiator located on floor above is shown; the front of garage having large doors and also a side door with cement floor causes the belt to be carried over the openings; traps are thus formed, and, while not detrimental to heating with this job, yet for safety when shut off drips are placed on all low points.

In conclusion, I want to again mention the sensitiveness of all hot water pressure heating work. The best results are demanded of all district heating companies, and, again, reliability, simplicity and, above all, economy are expected of the engineering department of the company.

Two other systems will be mentioned only as this paper has probably exceeded its bounds: both are what is termed overfeed—that is, the feed is carried to the top of building and fed downward—the return being in basement. The runs of the mains are similar but the branches for radiators are different; in the first a single-pipe making a vertical series is used, in which all radiators on that branch are in series and radiation must be figured for same; in the other the radiator branches are fed in multiple and the feed supplies all radiators, while a separate return pipe carries the cooled water from the radiators. Both can be used on pressure work, but the writer would strongly urge the last system for both gravity and pressure work. These overhead systems are recommended for buildings of more than three stories high and where attic room can accommodate the main.

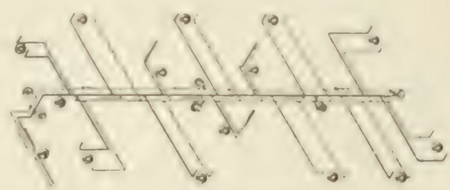


FIG. [illegible] ONE BELT THREE-PIPE UNDERFEED PRESSURE GRAVITY SYSTEM

New Scheme of Automatic Car Ventilation

An arrangement that may be used for ventilating enclosed buildings, but which is especially designed for street cars and railroad coaches, has lately been patented by Harry B. Leeming, of Salford, England.

The main features of the system are shown in the accompanying drawings. Use is made of a series of open sheet-metal or other cones of varying sizes arranged in line, the small end of one cone projecting into the larger, open end of the succeeding cone, and so on throughout the series. The intention is that a strong current shall be induced down the first cone and delivered at the smaller end into the larger end or mouth of the second cone, and thereby cause vitiated or foul air to enter the larger, open mouth of the second and succeeding cones, and so be swept on through the second cone, on to the third, and so on throughout the series.

A number of cones are strung together, or suitably supported, and, according to the essential novel feature of the invention, these are cut from one continuous conical tube, or to corresponding proportions. The conical sections so obtained from one continuous cone length are strung together and annular apertures are provided at regular or suitable intervals through which the vitiated air can enter and be swept along by the induced current traversing from end to end.

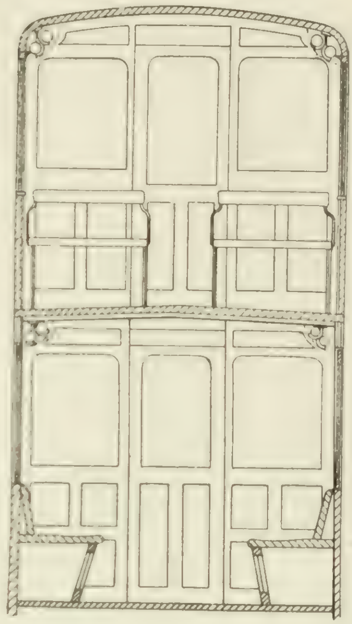


FIG. 3—SECTIONAL ELEVATION OF A DOUBLE-DECK TRAM CAR, WITH THE VENTILATING CONES APPLIED

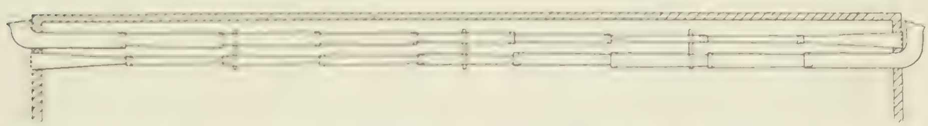


FIG. 1—SECTIONAL PLAN, SHOWING APPLICATION OF A SERIES OF CONES TO THE VENTILATION OF A STREET CAR

The scheme, as described, may be modified to suit various conditions. A fan, for instance, may be located at the exit to accelerate the flow of air. A nozzle or blowing device may also be utilized, as shown in Fig. 2, which would probably prove an advantage when the cones are fixed in a building.

In Fig. 3 the illustration shows two sets of a series of cones longitudinally disposed on each side of a tram-car, but any required number may be used, and they could, if desired, be located in air trunks in the car roof.

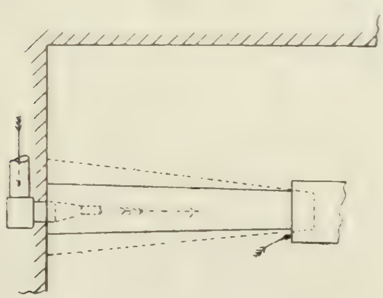
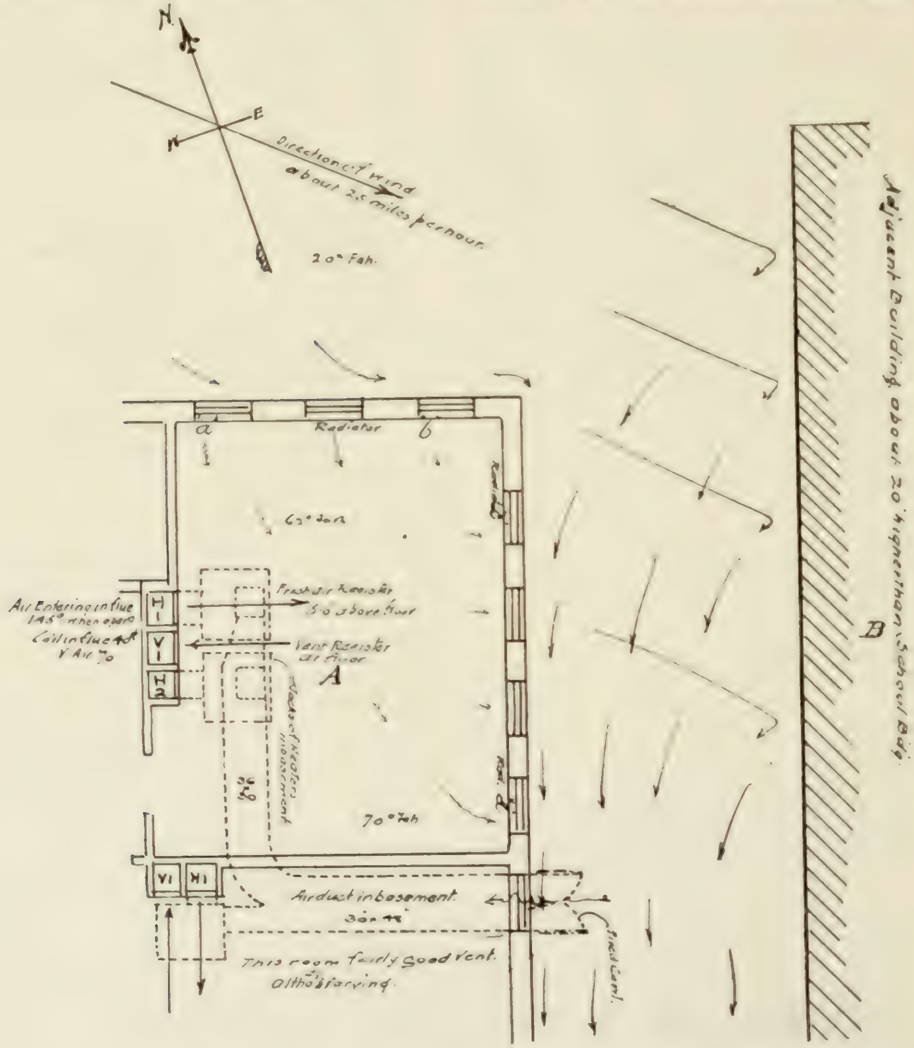


FIG. 2—VENTILATING CONES EQUIPPED WITH A NOZZLE OR BLOWING DEVICE

Wind Effects on Heating of Buildings

The accompanying sketch is intended to represent a school building, A, and its immediate surroundings. The adjacent building, B, is in the position shown. Fresh air inlets for the air supply, and exhaust outlets for the ventilation are as indicated. The adjacent building is about 20 ft. higher and about 20 ft. away.



SKETCH SHOWING EFFECT OF WIND ON HEATING OF SCHOOL BUILDING

When the wind was blowing from the northwest, I found that I could get very little air in the room, A, through the register. The wind would strike the adjacent building and follow the lines shown by the arrows, causing the air to vary in the fresh air registers, so that instead of a steady inflow at the register, there would be an outflow at times; that is, I could get a varying amount from nothing to 300 ft. velocity, and then suddenly reversing, so that my readings for one minute would show that there was no air registered.

I placed a temporary wind shield over the fresh air intake, and this I found corrected the difficulty. I then erected a permanent shield.

The room had three windows on the north side, and four windows on the east side. Placing my anemometer on the windowsill at a, I found there was an appreciable inflow through the closed window, caused by window leakage. Placing it at b, I found there was an inflow and outflow, also due to leakage. Testing at c, there seemed considerable leakage, and at d considerable outflow; these acted as a check on the inlet from the fresh air register.

Opening the window at a, of sufficient area to equal the size of heat flue or register, there was a positive inflow through this opening, and slightly less volume in the outflow in the vent register. Closing this window, and removing my anemometer to the window d and opening the same in proportion to the vent register, there was an outflow, and the vent register was found to be dead, as no air was passing through.

The effect was caused by the high wind striking the taller adjoining building, depressing the current, and sweeping through the space between the two buildings with rapid velocity in the lines shown by the arrows, causing a suction on the east side of the school building, which drew the air through the space around the sash at c and d sufficient to prevent the proper operation in the heat and vent flues. Placing the cowl over the intake to the fresh air flue assisted in supplying the air to the room independent of what leaked in and out through the sash. If the windows had been properly weather stripped there would have been less trouble with the inlet and vent outlet flues. —*Thomas Barwick, before the American Society of Heating and Ventilating Engineers.*

Ventilation and Heating of Public Buildings in 1859

The practice of heating and ventilation as it existed in 1859 is reported in a curious clipping from a New York newspaper which has come to light, reporting a lecture on the subject delivered by a Dr. Watson, in that year, at the New York Hospital. In this lecture Dr. Watson recounted to the large number of the medical profession and medical students who were present, the new ventilating apparatus, which was then under construction at the hospital, in connection with a new steam heating system.

"Two perpendicular shafts," he said, "each about 15 ft. high and 4½ ft. wide, internally, are in the open green at the north—the other, in the corresponding green at the south of the building, each at a distance of 30 ft. from it, having been erected and made to communicate beneath, with the underground air ducts of the same capacity, passing in a direct line onward from the upright shaft towards the center of the basement hall, and beneath it to within a few feet of the points at which the respective wings meet the central portion of the buildings. Each of these underground air-ducts, in its passage underneath the hall, gives off four laterally ascending branches, which open into a corresponding number of air chambers in the basement wings, the united capacity of the ascending branches being still equal to that of the main air duct, and both of them opening into its respective air chamber through the floor.

"In supplying pure air to the center of the house, three apparatuses are provided near the basement windows, one on either side of the front entrance, and one at the corresponding point in the rear. The air is introduced through them in such a way as to become somewhat tempered before reaching the three air chambers in the basement under the center part of the house, into which they open near the floor. From the eleven air chambers, four for each wing and three for the center, the air is conducted upward by ascending flues, all terminating near the floor of the respective apartments to which they lead, and retaining the united capacity equal to that of the external openings."

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Twenty-Third Annual Convention, Chicago, May 29-June 1, 1911

A notable and successful convention properly describes the twenty-third annual meeting of the National Association of Master Steam and Hot Water Fitters in Chicago, May 29-June 1, 1911. While the direct object of its coming to Chicago—namely, the affiliation of the Chicago master fitters with the National organization—was not realized, the gathering of so large a number of master fitters and members of the supply trade as were present and the scale on which the entertainment and other features were carried out mark the convention as one of the most important in the history of the association.

Through its three local associations of steam and hot water fitting contractors, Chicago materially swelled the attendance of the contractors. The Chicago Master Steam and Hot Water Fitters, the most important of the local bodies, had temporary headquarters in the Sherman Hotel, where the convention was held, and on behalf of all three local associations constituted itself as a Committee of Welcome. It was early made evident, however, that the desire, under present conditions, for an independent organization in Chicago was so overwhelming as to preclude all thought of union with the National body. The reasons, moreover, were frankly given as being largely due to the centering of the association's activities in the East, both in its general policy and in its details of organizaton.

Outside of the presence of so many Chicago master fitters, one of the most important contributing features to the success of the convention were the luxurious appointments of the hotel itself. A commodious banquet hall on the third floor was reserved for the regular sessions, while a hall immediately in the rear was utilized for the repast served by the Manufacturers' and Salesmen's Committee on the second night of the convention. Every convenience was at the disposal of the visiting members and guests, and added much to the general enjoyment.

In response to special invitations, many of the former presidents were on hand to participate in a reunion of the charter members and past-presidents. This feature of the convention was emphasized on account of the fact that the organization held its first meeting in Chicago in 1889. As many as possible of those whose faces appeared in the first convention photograph were invited to be present, and during the open session a photograph was made of the "old guard." In this connection Secretary Gombers read an interesting letter from Walter Higgins, of Washington, D. C., expressing his regret at not being able to be present. He was eighty-six years old on May 28.

Following various committee meetings, on Monday, May 29, the convention formally opened with an executive session Tuesday morning, May 30, held to perfect the convention details.

In the afternoon the convention met in open session, with President Charles A. Geoghegan in the chair. The Committee on Credentials, Alfred E. Kenrick, chairman, reported that 374 members were qualified to sit in the convention. In addition to the Credential Committee, other committee announcements were as follows:

COMMITTEES

NOMINATING.—S. A. Jellett, Pennsylvania; A. E. Kenrick, Massachusetts; L. W.

CONVENTION PHOTOGRAPH, NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS, CHICAGO, MAY 29-JUNE 1, 1911

Butterfield, New Jersey; A. E. Werkhoff, Indiana; Chas. J. Weibert, New York.

CONSTITUTION AND BY-LAWS—P. Gormly, Pennsylvania; W. C. Weatherly, Michigan; G. F. Kappel, New Jersey; U. G. Scollay, New York.

WAYS AND MEANS AND GOOD OF THE ORDER—E. B. Denny, New Jersey; J. T. Bradley, Missouri; D. A. Farrell, Georgia.

APPEALS AND GRIEVANCES—E. Grassler, Wisconsin; I. E. Shaw, Illinois; H. P. Cahill, Ohio.

AUDITING—W. J. Baldwin, Jr., New York; W. A. Lawson, New Jersey; W. H. Curtin, New York.

DISTRIBUTION OF REPORTS—W. M. Whitlock, New Jersey; George Suter, Missouri; G. H. Drake, New York.

President Geoghegan then read his address. He alluded to the fact that at the first convention of Master Fitters' Association the late Charles J. Gillis, who was Mr. Geoghegan's partner, was elected president of the Master Steam and Hot Water Fitters' Association of the United States. He also stated that the firm of which Mr. Gillis was partner—namely, Gillis & Geoghegan—has been a member of the association continuously since its organization, a period covering twenty-three years.

"The National association," continued Mr. Geoghegan, "was organized for the purpose of protecting our business against unscrupulous manufacturers who were interfering with the whole craft. Another object was the advancement of the trade in all the latest discoveries of science appertaining to the circulation of steam and hot water, and the several branches of ventilating, and to create a better feeling among all master fitters. And I can say, without fear of contradiction, that the National association has succeeded beyond its expectations up to the present day."

"Gentlemen," added Mr. Geoghegan, "let me tell you, when a name of a manufacturer has been removed from our List in Accord, all sorts of pressure are brought to bear to have it replaced, and it is replaced when the erring one gives his assurance that he will deal honestly in the future with our members."

After referring to the previous work of the association in securing the adoption of a schedule of standard flanges, in accordance with which all manufacturers now make flanges of uniform diameter and thickness, with uniform number, size and position of bolt holes, President Geoghegan continued, "Our Committee on Standardization, after five years' investigation and labor, has worked out a schedule for flanged fittings, both standard and extra heavy, and a committee of the American Society of Mechanical Engineers has coincided with our views thereon. The schedule also meets with the approval of a representative of the United States Navy Department (Commander Charles M. Dyson), who was in joint session with the committee when the schedule was finally passed upon."

A pamphlet containing the committee's recommendations on this subject was distributed at the convention.

"A number of manufacturers have already agreed to accept the schedule, so that we can safely say another milestone in the march of progress has been reached."

Of the other activities of the association Mr. Geoghegan said: "Our Committee on Standardization is working at the present time with the boiler manufacturers to try to have them properly rate their house-heating boilers, so that when you want to order a boiler that manufacturers claim will supply 100 sq. ft. of radiation, you can take their catalogues, look at the rating printed therein and know that the boiler will do exactly what they claim, and save you the annoyance and time turning from page to page to find out what the several conditions are.

"This National association," concluded Mr. Geoghegan, "made a very careful and thorough examination of the patents of the several vacuum heating systems and found that almost all of the so-called patents had expired; and to-day the members of the Master Fitters' Association throughout the country can install a vacuum heating system without paying royal-

ties to anybody. We had no desire to interfere with the business of any reputable manufacturer or dealer placing on the market any patented article, or improved method of installing any kind of heating, ventilating or power plants, such as our members are interested in, but we did intend to put a stop to the unfair and unjust demands made upon our members and threats conveyed to our customers by those who thought their business interests were best served by following such methods."

REPORT OF BOARD OF DIRECTORS

The Board of Directors, in its report, referred to the vacuum heating patents situation by stating:

"The subject of vacuum heating systems, which required so much attention during the years 1909-1910, was so effectually treated that its ghost seems to have been laid. We have no complaints in this line from members, and know of no case where members have been disturbed by threats or lawsuits when the suggestions of our printed reports were followed."

The board reported that the matter of a change in the association's "Trade Resolutions" had been under consideration as a result of discussion at the last convention, and that after conferences with several manufacturers a proposed alteration in the "Trade Resolutions" was prepared which would be presented in executive session.

The board's report also stated that in the matter of rating house-heating boilers the most difficult questions have been carefully considered, and that, as a result of many conferences with manufacturers, conclusions had been reached which will soon result in such ratings for house-heating boilers as well surely commend the work of the Standardization Committee to every master steam fitter.

In the expectation that some action would be taken on the subject of boiler ratings, a large representation of boiler manufacturers was on hand at the Wednesday morning session, May 31, but the matter was referred back to the committee.

The report concluded with an earnest invitation to the Chicago master fitters, and to other non-members, to become affiliated with the National association. The report was signed by Edward B. Denny (chairman), J. A. Almirall, N. P. Bishop, John T. Bradley, Charles A. Geoghegan, P. F. Maginn, William H. Oakes and John T. Sadler.

STANDARD UNIFORM FLANGED FITTINGS

N. Loring Danforth, for the Committee on Standardization, presented a detailed report of the committee's work, which stated:

"A few years ago the possibility of standardizing fittings so that all makes would be uniform in every essential detail was hardly thought of; it looked so improbable a task. To-day we can safely say that within the next six months manufacturers will be making standard uniform flanged fittings, provided the members of this association will back up what your Board of Directors and Standardization Committee, together with a committee of the American Society of Mechanical Engineers have adopted, and will shortly present to the manufacturers as the standard. If only a few manufacturers accept it at first these are the ones we want to stand by and show them we appreciate their desire to do what everyone recognizes as a necessity in bettering trade conditions. Our members should feel proud to know that our association took the initiative in this important engineering problem, and that we are recognized as an association of able contracting engineers who want to work with other National engineering societies in bringing this branch of engineering to as high a point of perfection as possible.

"A great deal of credit is due to Mr. William T. English, of our committee, who has devoted a considerable amount of time to compiling the lists and arranging the detail drawings of the fittings, all of which were made in his office, under his personal supervision, and which took months to complete. As we all know, at the present time flanged fittings made by many different manufacturers nearly all vary in some dimensions, so that if a fitting

breaks, or if for any reason we must change a fitting in a main, it necessitates getting a new fitting from the same pattern as the old one, and if this cannot be done it may be necessary to change a length of pipe, which often requires a great amount of time and labor. This question not only affects us as contractors, but often the owner suffers where his plant is shut down for hours or days waiting for repairs which could be made very quickly if the fittings were of standard dimensions.

RATING HOUSE-HEATING BOILERS

"In the matter of arriving at a standard for rating house-heating boilers, we have made less progress than we hoped to. We have, however, made some definite progress which we think will show results in the near future. By continually agitating the subject, we have been able to get the engineers, manufacturers, and even some of the architects interested, and they all see the necessity for some uniform method of testing and a proper basis for rating boilers used for house-heating purposes. We know that some manufacturers are now making tests along lines which we have outlined as house-heating conditions, and when the results of these tests have been compiled it will be possible for them to give conservative ratings, which for house-heating conditions should be generally satisfactory. Our committee has made some tests at one of the large boiler manufacturer's plants, and has gathered from many members of the association the results of their individual experiences, and we have tried to compile in a fair way, and as concisely as possible, what we consider to be actual house-heating conditions.

"Manufacturers should be able to guarantee their boilers under these conditions, and rate them accordingly. If the boiler manufacturers will not rate their boilers under house-heating conditions, we will at least try to get from them the results of their tests made under these conditions, and from the data we receive we may be able to give the members information so they can determine for themselves, more accurately than now, what ratings different boilers should have under house-heating conditions.

"This subject is an important one, and the committee would like to hear from members who have information which they are willing we should have, and the more information we get from members, even if it is only their unfortunate experiences with different boilers, will materially help the committee when meeting the manufacturers and trying to get them to see this subject as we do, as contractors.

"The members of this association can do more in the matter of getting proper ratings for house-heating boilers than any committee can. The committee can formulate conditions as nearly right as possible and can ask the manufacturers to comply with these conditions; but where manufacturers think it may be detrimental to their interests to give us boiler ratings such as we ask them, we must stand firm and demand fairness and recognize substantially those manufacturers who are fair. We have asked some of the manufacturers to consider the question of giving us ratings on all house-heating boilers in accordance with the amount of coal burned per hour per square foot of grate, when the boiler is fired at stated periods. We hope in this way to be able to tell at a glance what a boiler will do under different conditions of firings and amounts of coal burned. In fixing the amount of coal to be burned and the periods of firing, we have had to take the experience of those who have given us their experience. You can see how important and necessary it is for members to take a personal interest in accumulating data on subjects pertaining to this branch of engineering and letting our committee have the benefit of your experience."

The report was signed by Wm. J. Baldwin, Jr. (chairman), N. Loring Danforth, Wm. P. Kirk, Edward B. Denny and Charles A. Geoghegan.

BIDDING FOR WORK THROUGH GENERAL CONTRACTORS

The Committee on Trade Relations devoted its report, which was read by

E. B. Denny, chairman, to a discussion of the practice of sub-contracting on the part of master fitters. Following are the principal portions of the report:

"This subject has been agitated for some years, and, as a result, much of the important work in our business is let separately, and many of our best concerns refrain almost entirely from sub-contracting. Still, much important work is done through general contractors, and most of it without ultimate profit to the sub-contractors. Why should the practice continue; or why should otherwise sane business men continue a practice which is admitted to be ultimately ruinous? Is it not in a measure because no practical means are in their hands by which much of it could be avoided and the practice discredited? We believe that much business now done in this unprofitable way could be secured direct if plain but adequate reasons for the change could be presented at the proper time and in concrete form. We therefore recommend that such reasons as we suggest below be printed and in the hands of our members, for use as occasion or opportunity arises:

"1. Why should a broker or general contractor, who has no expert knowledge of such work, intervene at the expense of the owner either in money or character of plant installed?

"2. The minimum of risk assumed is admitted to be the best business practice.

"3. Direct contracting with the owner means the minimum risk in most cases.

"4. Accepting the broker or general contractor, in lieu of the owner, is increasing business risk, with no adequate return, and is not good business practice.

"5. Dealings through general contractors mean that the sub-contractor's capital is often used to carry on the general contractor's business. This is a form of philanthropy, and not of business.

"6. Where it is necessary that the work be done under a general contract, we recommend that bids be submitted to, and be opened by, the owner or his direct representative, and the contract be awarded to the acceptable bidder, who may then have his figures incorporated in the general contract."

The report was signed by E. D. Denny (chairman), J. P. Gallivan, C. A. Geoghegan, F. P. Hill, H. Middleton, S. Wright and G. F. Kirkhoff.

The secretary's and treasurer's reports were then presented, the treasurer's report showing:

Cash on hand May 1, 1910.	$8,622.61
Receipts, May 1, 1910, to May 1, 1911	14,652.03
Making a total of....	$23,274.64
Expended, May 1, 1910, to May 1, 1911............	15,209.28
Cash balance May 1, 1911.	$8,065.36

The report was signed by J. A. Almirall, treasurer.

PENNSYLVANIA STATE ASSOCIATION ON SUB-CONTRACTING

The Pennsylvania State Association presented the following resolutions, which were unanimously adopted at its convention in Pittsburg, May 28, with a request for their consideration by the National association. They were referred to the incoming Board of Directors:

"1. Resolved, as it is the sense of this association that the heating apparatus is a part of the finishing of a building, we recommend that the practice of bidding to general contractors be discontinued, and in lieu thereof bids be tendered to the owner or his representative.

"2. Resolved, that we consider charges for boxing and crating material as unfair and unjust extra charges; are therefore opposed to it, and recommend some action on the part of the National association to have the practice discontinued.

"3. Resolved, as the sense of this association that boiler manufacturers making sales of boilers, radiators and repairs, etc., direct to consumers cannot expect to be retained on our accord list.

"4. The convention directed that

membership committees representing various districts of the state be appointed to canvass and solicit members; and in this connection request the National association to assist in our efforts to increase the membership by sending an organizer through the state of Pennsylvania."

The first session on Wednesday morning, May 31, was behind closed doors. In the afternoon, at an open session, new officers were elected and installed, the past presidents and charter members present were photographed in a body, and a special address was delivered by Richard T. Crane, president of the Crane Co., Chicago. A paper by Edward P. Bates, of Syracuse, N. Y., was read by Secretary Gombers.

New Officers

The new officers elected were as follows:

PRESIDENT

Edward B. Denny, Newark, N. J.

VICE-PRESIDENT

John T. Bradley, St. Louis, Mo.

TREASURER

J. A. Almirall, New York.

BOARD OF DIRECTORS

Charles A. Geoghegan, New York; P. F. Maginn, Pittsburg; William H. Oakes, Boston; G. F. Kirkhoff, Indianapolis; Samuel Wright, Buffalo.

The Entertainment Features

Under the supervision of President William G. Le Compte, of the Manufacturers' and Supply Men's Entertainment Committee, a programme of entertainment for the delegates and ladies and other guests was carried out in a manner that brought forth the heartiest expressions of praise. The enjoyment of the various outings was enhanced by the beautiful weather which prevailed throughout the convention.

Immediately after the opening session a meeting of the committee was held, with President Le Compte in the chair. A. S. Armagnac was made temporary secretary and Joseph Graham, temporary treasurer.

A committee on rifle range was appointed, consisting of Emmons Collins, A. M. Nichols and F. E. Whiting; also a committee on bowling alleys, composed of P. H. Pinder, A. S. Armagnac and C. A. Miller.

Before adjournment the meeting re-elected William G. Le Compte president; Frank K. Chew, secretary, and M. E. Danforth, treasurer.

The following firms responded to the invitation to share in the expenses incident to the entertainment as planned:

H. B. Smith Co., Westfield, Mass.
Jenkins Bros., New York.
Warren Webster & Co., Camden, N. J.
Bishop-Babcock-Becker Co., Cleveland, O.
H. W. Johns-Manville Co., New York.
Powers Regulator Co., Chicago.
Standard Steam Specialty Co., New York.
United States Radiator Corporation, Detroit, Mich.
Iroquois Engineering Co., Chicago.
American Radiator Co., Chicago.
C. A. Dunham Co., Marshalltown, Ia.

MASTER FITTERS WIN RIFLE MATCH

The first event on the programme was a rifle match, Tuesday evening, May 30, at Free's Rifle Gallery, between the Master Fitters and the supply men. This match resulted as follows:

MASTER FITTERS

Name.	Score
William J. Baldwin, Jr.	473
P. F. Maginn	[illegible]
John [illegible] Sadler	[illegible]
J. A. Almirall	471
H. B. Gombers	[illegible]
Total	2308

SUPPLY MEN

William G. Le Compte	481
R. B. Flershem	458
Edward E. McNair	452
Frank B. Howell	471
Theo. F. Humphreys	387
Total	2249

The two men on each side having the highest scores continued the match with the following results:

MASTER FITTERS

Name.	Score.
William J. Baldwin, Jr.	479
J. A. Almirall	470
Total	949

SUPPLY MEN

William G. Le Compte	473
Frank B. Howell	466
Total	939

THE BOWLING MATCHES

The Master Fitters were also successful in the bowling match Wednesday evening against the supply men. The result of this match is shown herewith:

SUPPLY MEN

	1st G.	2d G.	3d G.
C. A. Miller........	131	193	102
H. B. McLelland...	126	188	168
L. H. Drury........	113	135	120
A. M. Nichol	75	139	112
J. T. Stackhouse...	141	136	140
Totals............	586	752	642

MASTER FITTERS

	1st G.	2d G.	3d G.
G. H. Zellers......	121	188	104
E. F. Joy	110	167	190
H. W. Chapman..	155	127	178
H. B. Gombers...	132	100	116
W. J. Baldwin, Jr.	140	120	132
Totals	670	711	720

Fifteen ladies participated in the ladies' bowling match, with the following results, the ten prize winners being given in the order named:

LADIES' BOWLING SCORES

Miss B. M. Zellers, Washington, D. C.	131
Mrs. F. H. Fowler, New York	[illegible]
Miss N. E. Zellers, Washington, D. C.	[illegible]
Mrs. W. J. Woolley, Evansville, Ind.	97
Mrs. H. W. Chapman, New York......	[illegible]
Mrs. N. P. Bishop, New Haven, Conn.	79
Mrs. J. T. Bradley, St Louis.........	69
Mrs. C. A. Geoghegan, New York...	67
Mrs. J. A. Ziesse, Grand Rapids, Mich.	64
Mrs. H. B. McLelland, Chicago......	58
Mrs. Frank Leavery, Syracuse, N. Y.	58
Mrs. H. B. Gombers, New York.....	53
Mrs. J. S. Knee......................	50
Miss M. Birge, New York..........	44
Mrs. G. H. Zellers, Washington, D. C.	34

Immediately following the completion of the bowling matches, the entire party repaired to one of the banquet halls of the Hotel Sherman, where a midnight supper was served, consisting of lobster and chicken salads, ice cream, coffee and cigars; also sauterne and champagne.

The banquet hall presented a pretty sight as the eighty-three diners sat down at practically one table, which extended along three sides of the apartment. Here the prizes for both the rifle match and bowling tournament were presented.

Mr. Le Compte, as president of the Entertainment Committee, acted as toastmaster and filled the rôle with marked success. His first act was to appoint John T. Bradley, the new vice-president of the Master Fitters' Association, as sergeant-at-arms to see that the prizes reached the right hands. Mr. Le Compte then named John C. F. Trachsel and Elias D. Smith as escorts to the prize winners, the prizes being displayed on a table in the center of the room, each winner taking his or her choice, in order.

The efforts of the escorts to be first in reaching the prize winners as their names

GROUP OF CONVENTION GUESTS AT THE SOUTH SHORE COUNTRY CLUB, CHICAGO

were announced, brought forth screams of laughter and were only equaled by the persistent attempts of Mr. Bradley to hoist a certain green parasol upon each lady as she arrived to make her selection.

So swiftly and delightfully was the time passed that it was in the "wee sma' hours' before the company broke up, a fact that was brought to the attention of the diners by Mr. Gormly who, in a few informal remarks, said he was not accustomed to make "after-breakfast" speeches.

Before breaking up, however, a vote of thanks was passed to the manufacturers and supply men for the hospitality. An anticipatory vote of thanks was also tendered to the American Radiator Company for the plans that had been made to entertain the convention on the following day.

AUTOMOBILE RIDE AND LUNCHEON AT THE SOUTH SHORE COUNTRY CLUB

A fitting climax to the pleasures of the convention was the outing for the members and guests of the association, which was planned and carried out by the American Radiator Company.

Immediately after the final adjournment of the convention on Thursday morning, June 1, automobiles were in waiting and the entire company was taken on a charming ride down Michigan avenue, and then through Washington and Jackson Parks to the South Shore Country Club.

Perfect weather conditions made the trip an ideal one. Arriving at the handsomely-appointed clubhouse the party, after a few minutes' rest, sat down to a daintily prepared luncheon in a dining room directly facing Lake Michigan, whose green and blue water danced like champagne in the sunlight.

The arrangements made through Chas. K. Foster, vice-president and general manager of sales of the American Radiator Company, were perfect to the last detail and a toast proposed during the luncheon to Mr. Foster was drunk standing. Another toast to the new president of the National Association of Master Steam and Hot Water Fitters, E. B. Denny, was drunk with equal enthusiasm.

After a delightful stroll on the club lawns, during which a group photograph was taken, the party was carried back to the city along the lake front and through typical residential sections.

MEMBERS AND GUESTS

Edward B. Denny, Newark, N. J.
Charles A. Geoghegan, New York.
J. A. Almirall, New York.
H. B. Gombers, New York.
John C. F. Trachsel, Philadelphia, Pa.
M. G. Sellers, Philadelphia, Pa.
George H. Kirkhoff, Indianapolis, Ind.
J. T. Bradley, St. Louis, Mo.
Stewart A. Jellett, Philadelphia, Pa.
N. L. Danforth, Buffalo, N. Y.
W. J. Baldwin, Jr., New York.
T. B. Cryer, Newark, N. J.
E. F. Capron, Chicago, Ill.
J. T. Sadler, Elmira, N. Y.
C. H. Simmons, Chicago, Ill.
E. A. Cleland, Lynchburg, Va.
W. S. Patterson, Appleton, Wis.
T. J. Douglass, Chicago, Ill.
F. W. Lamb, Chicago, Ill.
A. W. Michel, Detroit, Mich.
H. Middleton, Baltimore, Md.
W. P. Kirk, Bridgeport, Conn.
I. E. Shaw, Gardner, Ill.
E. Hasey, Milwaukee, Wis.
W. Dougherty, Syracuse, N. Y.
George H. Drake, Buffalo, N. Y.
Samuel Wright, Buffalo, N. Y.
B. W. Brady, Chicago, Ill.
J. J. Collins, St. Louis, Mo.
C. E. Hasey, Minneapolis, Minn.
George Suter, Sedalia, Mo.
H. W. Chapman, New York.
P. Gormly, Philadelphia, Pa.
W. J. Olvaney, New York.
U. G. Scollay, Brooklyn, N. Y.
C. J. Wiebert, Brooklyn, N. Y.
A. B. Weaver, Buffalo, N. Y.
P. T. Maginn, Pittsburg, Pa.
G. H. Zellers, Washington, D. C.
W. P. Thompson, Pittsburg, Pa.
L. C. Rhoades, Rennselaer, Ind.
William Schober, Park Ridge, Ill.
Alfred E. Kenrick, Brookline, Mass.
W. H. Curtin, Brooklyn, N. Y.
W. J. O'Brien, Brooklyn, N. Y.
D. A. Farrell, Atlanta, Ga.
Frank Traver, Syracuse, N. Y.
W. B. Graves, Chicago, Ill.
Herman Appel, Sandusky, O.
L. W. Butterfield, Orange, N. J.
A. Daniels, Cincinnati, O.
Walter A. Lawson, Newark, N. J.
William Woolley, Evansville, Ind.
Robert Ernst, Detroit, Mich.
Joseph A. Langdon, Pittsburg, Pa.
John O'Donnell, Evansville, Ind.
Edward F. Joy, Syracuse, N. Y.
E. R. Steinmetz, Philadelphia, Pa.
H. P. Cahill, Akron, O.
H. L. Brown, Cassopolis, Wis.
C. J. Fox, Milwaukee, Wis.
Otto Biefield, Watertown, Wis.
Rud. Zuehlke, Milwaukee, Wis.
J. A. Ziesse, Grand Rapids, Mich.
J. A. Diggle, Indianapolis, Ind.
A. E. Werkhoff, Lafayette, Ind.
W. C. Weatherly, Grand Rapids, Mich.
W. H. Powell, Anderson, Ind.
J. S. Knee, Grand Rapids, Mich.
W. M. Whitlock, Newark, N. J.
R. C. Faunt, Milwaukee, Wis.
E. Grassler, Milwaukee, Wis.
J. F. Garvey, Mason City, Ia.
M. H. Markey, Lewisburg, O.
C. S. Thompson, Atlantic City, N. J.
N. L. Gaskell, Atlantic City, N. J.
I. E. Shaw, Gardner, Ill.
Edward Kanney, Laporte, Ind.
S. A. Schmitt, Evansville, Ind.
W. C. Wright, Chicago, Ill.
A. J. Stuebel, Milwaukee, Wis.
P. H. Kendricken, Boston, Mass.
E. Tunstead, Minneapolis, Minn.
H. W. Tuttle.
J. H. Cook, Chicago, Ill.
James I. Pope, Chicago, Ill.
M. E. Flaherty, Milwaukee, Wis.
N. E. Füst, Chicago, Ill.
George M. Getshow, Chicago, Ill.
E. D. Smith, Elizabeth, N. J.
E. N. Murphy.
G. F. Kappel, Camden, N. J.
William A. Pope, Chicago, Ill.
George H. Reynolds, Chicago, Ill.
W. A. Mertz, Chicago, Ill.
W. L. Thompson, Chicago, Ill.
W. M. Lindder, Chicago, Ill.
F. J. McMaster, Chicago, Ill.
E. G. Melum, Chicago, Ill.
J. J. Herlihy, Chicago, Ill.
E. R. Steinmetz, Chicago, Ill.
Charles F. Newport, Chicago, Ill.

Cordez Heat Supply Co., Milwaukee, Wis., R. Cordez, president.

Pressed Radiator Co. of America, *Pittsburg*. George B. Carr, manager Chicago branch, and Arthur W. Becker, assistant manager.

Suburban Water Supply Co., Chicago, Joseph B. Rider, chief engineer.

Warnecke-Derringer Co., Minneapolis, Minn., W. Warneke.

Vapor Heating Co., Philadelphia, J. J. McKenna.

McDonald Vacuum and Vapor Specialty Co., Cleveland, O., J. J. McDonald, manager.

Patterson-Allen Engineering Co., New York, Thomas M. Mayer.

Bishop-Babcock-Becker Co., Cleveland, O., W. S. Ransom, Emmons Collins, George L. Fitz and A. F. Phillippi.

Rapid Calculator Co., Chicago, L. C. Hine and William B. Bostian.

Powers Regulator Co., Chicago, F. W. Powers and A. E. Schad.

Jas. B. Clow & Sons, Chicago, N. E. Frost, manager heating department.

American Blower Co., Detroit, Mich., A. M. Nichol.

Scully Steel and Iron Co., Chicago, H. T. Gielow.

J. H. Williams Co., Brooklyn, C. E. Hathaway.

George M. Newhall Engineering Co., Chicago, James A. Curtis.

P. Watson Specialty Co., Terre Haute, Ind., B. L. Watson.

Western Kieley Steam Specialty Co., Chicago, P. Boyleston, A. E. Heinze and H. J. Richter.

Carson Die and Tool Co., Chicago, F. P. Gillett and J. Fieldhouse.

Crane Co., Chicago, R. T. Crane, president; J. B. Berryman, secretary; J. A. Minwegen, engineering department, and E. P. Cole.

American Radiator Co., Chicago, Charles K. Foster, C. M. Parker, W. H. Hill, Louis Brown, F. B. Howell, E. J. Holland, R. B. Flershem, D. E. Kennedy, W. M. Scudder, A. K. Root, James H. Davis, F. S. Whitelaw, George D. Hoffman, L. H. Drury and M. J. Beirn, Jr.

United States Radiator Corporation, Detroit, Mich., Frederick W. Herendeen, general manager of sales; J. J. Blackmore, secretary; W. M. Foster, C. A. Barker, J. M. Chapman, Jr., E. E. McNair, Chicago, manager; Joseph Piraux, Jr.

H. W. Johns-Manville Co., New York, J. R. Andrews.

B. F. Sturtevant Co., Hyde Park, Mass., J. E. Anderson, Jr., Chicago manager.

Automatic Heating Co., Chicago, James E. Heg, Charles E. Warsop and S. F. Brunette.

Kewanee Boiler Co., Kewanee, Ill., J. P. Dugger and A. T. Kellogg.

H. L. E. Petersen, Elgin, Ill., H. L. E. Petersen.

National Steam Specialty Co., Chicago, H. H. Ludwig.

Western Valve Co., Chicago, P. S. Hudson.

S. Wilks Mfg. Co., Chicago, Charles C. Hughes, sales manager.

Standard Sanitary Mfg. Co., Chicago, J. A. Noone, manager Chicago office.

C. A. Dunham Co., Marshalltown, Ia., J. W. Hook, George W. Best, chief engineer.

H. B. Smith Co., Westfield, Mass., Theo. F. Humphreys and Charles A. Miller.

Michigan Pipe Co., Bay City, Mich., Henry B. Smith, Sr.

Walworth Mfg. Co., Boston, George T. Coppins.

International Sprinkler Co., Chicago, F. M. Link.

Jenkins Bros., New York, W. G. LeCompte, C. J. Jackson and H. B. McLelland.

Consolidated Engineering Co., Chicago, B. Van Auken and R. E. Goldschmidt.

McCrum-Howell Co., New York, A. H. Schroth, William A. Cameron, Thomas J. Cusack, Jr., W. J. Tanyan, Paul R. Schramke, E. H. H. Murray, William Lees, Joseph S. Hailwood, S. O. Dugger, W. H. Coughlin, S. J. Warnock, E. V. Bishop, C. A. Gunther, J. C. Watchett, F. V. O'Neill, Charles E. Dickinson and A. E. Heinze.

Novelty Iron Works, Canton, O., George E. Downe.

Warren Webster & Co., Camden, N. J., John F. Hale, William G. Braemer, J. F. Tuttle, B. Natkin, R. G. Rosenbach and W. H. Chanoweth, Jr.

Manning, Maxwell & Moore, New York, C. Monroe Smith.

International Heater Co., Utica, D. E. McCabe, Chicago manager.

Spencer Self-Adjustable Wrench Co., Minneapolis, Minn., F. S. Spencer.

Williams Tool Co., Erie, Pa., C. A. Eaton.

Standard Steam Specialty Co., New York, P. H. Pinder.

Kroeschell Bros. Co., Chicago, W. L. Kroeschell, A. H. Goetz.

Gurney Heater Mfg. Co., Boston, H. J. Knorr and R. W. Hillman.

Iroquois Engineering Co., Chicago, James J. McAleer, W. L. Bronaugh, R. J. Fitzgerald.

Evans-Almirall Co., New York, J. A. Almirall and Benjamin Kauffman.

Heating and Ventilating Magazine, New York, A. S. Armagnac.

Metal Worker, New York, Frank M. Bailey, F. E. Whiting and Roy F. Saule.

Domestic Engineering, Chicago, Harry de Joannis and Frank Keeney.

Engineering Review, New York, Joseph Graham and George H. Kauffman.

Plumbers' Trade Journal, New York, J. P. Morley, George W. Wood and Albert W. H. Spear.

The Master Steam Fitters' Organizations of Chicago

Chicago boasts of no less than three flourishing organizations of steam and hot water fitting contractors. In view of the recent agitation of the possibility of one or all of these bodies becoming affiliated with the National Association of Master Steam and Hot Water Fitters, it is interesting to understand their local status.

The original organization is the Chicago Master Steam and Hot Water Fitters' Association. This body comprised and still comprises practically all of the important contracting firms in this line in Chicago. The Association, however, has never had a large membership for any length of time and at present is limited to some twenty firms.

There was at one time a brief period during which the majority of all the steam fitting contractors in Chicago were admitted to membership. But the organization quickly became top-heavy, the smaller contractors being able to outvote the larger firms and thus controlling the Association's policy.

This led to a rupture and for a time the Association was quiescent if not, indeed, out of existence. In the reorganization, which took place later, the select few again comprised the membership and the other contractors proceeded to form an organization of their own, which they called the Chicago Steam Heating and Ventilating Engineers.

A number of the members of this body confined their work largely to plumbing contracting. There were apparently some firms in the original organization, also, who were both heating and plumbing contractors, because in the recent labor war in Chicago between the journeymen steam fitters and plumbers, members of both employers' associations formed the nucleus of a third master fitters' organization known as the United Heating and Power Association of Chicago. This third organization is made up entirely of firms which have agreed to use steam fitters belonging to the plumbers' union to the exclusion of those belonging to the steam fitters' union.

At the recent convention of the Na-

tional Association of Master Steam Fitters in Chicago, all three of the local organizations participated in the welcome, although it was made directly through the Chicago Association of Master Steam and Hot Water Fitters. This body had a special room at the Hotel Sherman, which was the headquarters for the convention, and among those who registered there were the retiring president, Charles A. Geoghegan, and the treasurer, J. A. Almirall.

Many courtesies were shown the visiting master fitters and there could be no doubt that the Chicago contractors felt and were glad to express the kindliest of feelings for the members of the National Association.

Among those registering at the Chicago Association's headquarters, whose names are not included in the regular attendance list, are the following:

J. J McKenna, Philadelphia.
Benjamin Kauffman, Chicago.
John Boylston, Chicago.
J. A. Cook, Chicago.
A. H. Goetz, Chicago.
S. R. Lewis, Chicago.
F. J. Englehart, Chicago.

National District Heating Association

THIRD ANNUAL CONVENTION, PITTSBURG, PA., JUNE 6-8, 1911

With a full programme and under favorable conditions of time, place and weather, the National District Heating Association held its third annual convention at the Fort Pitt Hotel, Pittsburg, June 6-8, 1911. The sessions were held in the English room of the hotel, which is of such ample proportions that a part of the hall was allotted to exhibitors, who made a varied and most interesting display

A. D. SPENCER, DETROIT, MICH.
Newly-elected President, National District Heating Association

The first professional session was called to order by President George W. Wright, of Baltimore, who introduced Mr. H. M. Irons, of Pittsburg. Mr. Irons greeted the association on behalf of the mayor. The president then introduced Mr. Garland, vice-president of the Pittsburg Chamber of Commerce, who also welcomed the association to the city.

President Wright then delivered his address in which he dwelt on the rapidly widening field of central station engineering and the many new problems constantly confronting the profession. "Most engineers," he added, "have their scrap heaps which serve to keep their conceit within bounds, and if we have the opportunity it would be well for us to look their exhibits over, as it may inspire us to do better work than the owners of the junk piles."

President Wright suggested the adoption of an official emblem which could be placed on a lapel button or pin.

SECRETARY-TREASURER'S REPORT

In his report Secretary-Treasurer D. L. Gaskill gave the total receipts for the year as $2,482.24, including a balance on hand at the beginning of the year of $164.49. The expenditures were $2,251.38, leaving a balance of $230.86.

An increase in active membership was reported, 62 active members and 14 associate members having been elected during the year.

NEW MEMBERS

The following is a list of the applications for active membership received during the last year:

Evans, Almirall & Co., Chicago, Ill.
Otto E. Osthoff, care H. M. Byllesby & Co., Chicago, Ill.
Michigan Power Co., Lansing, Mich.
Merchants Light, Heat & Power Co., San Francisco, Cal.
Harrisburg Steam Heat & Power Co., Harrisburg, Pa.
Tuscarawas County Electric Light, Heat & Power Co., New Philadelphia, Ohio.
Ernst Schiele, Hamburg, Germany.
York Steam Heating Co., York, Pa.
Erie Company, Erie, Pa.
The Edison Electric Illuminating Co., West Chester, Pa.
Dunkirk Power & Heating Co., Dunkirk, N. Y.
Andrews Heating Co., Minneapolis, Minn.
Waukesha Gas & Electric Co., Waukesha, Wis.
Cheyenne Light, Fuel & Power Co., Cheyenne, Wyo.
Grinnell Electric & Heating Co., Grinnell, Iowa.
Missoula Light & Water Co., Missoula, Mont.
M[illegible] Ohio.
F. M. Sinsabaugh, 1009 Main St., Mt. Vernon, Ill.
Frank K. Chew, Editor *The Metal Worker*, New York City.
D. L. Gaskill, Greenville, Ohio.
Miami University Light Plant, Oxford, Ohio.
City Steam Heat & Power Co., Pittsburg.
E. M. Bendure, Central Station Heating Co., Buffalo, N. Y.
W. E. Best, Seattle-Tacoma Power Co., Seattle, Wash.

The following is a list of the applications for associate membership received during the last year:

The Electrical World, New York City.
Westinghouse Machine Company, East Pittsburg, Pa.
Jenkins Brothers, Farnham Yardley, vice-president, New York City.
Richards-Wilson Pipe Covering Co., Grand Rapids, Mich.
H. W. Johns-Manville Co., Pittsburg, Pa.
National Valve & Mfg. Co., Pittsburg, Pa.
J. C. McQuiston, Westinghouse Dept. of Publicity, East Pittsburg, Pa.
Builders Iron Foundry, Providence, R. I.
The Powers Regulator Co., Chicago, Ill.
Power Specialty Co., New York City.
Power, 505 Pearl St., New York.

GROUP OF DELEGATES AT THIRD ANNUAL CONVENTION OF NATIONAL DISTRICT HEATING ASSOCIATION, PITTSBURG, JUNE 6—8, 1911.

Penn Central Light & Power Co., Altoona, Pa.
DeKalb-Sycamore Electric Co., DeKalb, Ill.
Hazelton Steam Heating Co., Hazelton, Pa.
Norristown Steam Heat Co., Norristown, Pa.
Georgia Railway & Electric Co., Atlanta, Ga.
The Denver Gas & Electric Light Co., Denver, Colo.
North Shore Electric Co., Chicago, Ill.
Albert Lea Light & Power Co., Albert Lea, Minn.
Taylorsville Gas & Electric Co., Taylorsville, Ill.
E. J. Bechtol, Detroit, Mich.
Davenport Gas & Electric Co., Davenport, Iowa.
Frankfort Heating Co., Frankfort, Ind.
The Washington Electric Light & Power Co., Washington, Pa.
E. B. Tyler, Wilkinsburg, Pa.
Merchants Heat & Light Co., Indianapolis, Ind.
Yakima Artificial Ice & Cold Storage Co., North Yakima, Wash.
F. C. Chambers, Springfield Light, Heat & Power Co., Springfield, Ill.
A. Beaurrienne, Paris, France.
Red River Power Co., Grand Forks, North Dak.
Edison Elec. Illuminating Co., Cumberland, Md.
Central N. Y. Gas & Elec. Co., Geneva, N. Y.
Federal Engineering Co., Pittsburg, Pa.
Estate of Henry W. Oliver, Pittsburg, Pa.
Edwin Ehinger & Co., Toledo, Ohio.
Canton Gas & Electric Co., Canton, Ill.
Northern Heating & Elec. Co., St. Paul, Minn.
Kenosha Gas & Electric Co., Kenosha, Wis.
D. A. Bonitz & Co., Chicago, Ill.
E. F. Capron, 175 N. Dearborn St., Chicago, Ill.

A report of the Committee on Data was read from text by E. J. Kiefer, of Easton, Pa., chairman, but as it had arrived too late for publication with the other papers, and as the committee was not through with its work, the report was held over, and on motion the committee was continued.

As it was still early in the afternoon two papers on Thursday's programme were advanced and presented at this session, one on "The Heating and Ventilating Equipments of the City Investing Building, New York City," by J. Byers Holbrook (read by Secretary Gaskill), and the other on "Handling Customers," by President G. W. Wright, Mr. Wright's paper being discussed at length.

MORNING SESSION, JUNE 7

The first paper at the Wednesday morning session was on "Heating Franchises," by A. C. Gillham, of the Central Station Engineering Co., Chicago. In the absence of Mr. Gillham this paper was read by W. H. Schott.

Prof. John R. Allen presented a most interesting paper on "Coefficients of Heat Transmission." He reported that the University of Michigan is now engaged in an elaborate series of experiments to determine more accurately the transmission of heat through various building materials.

This was followed by a paper by F. C. Chambers, Springfield (Ill.) Light, Heat and Power Co., on "Results of Measuring Station Load by Venturi and General Electric Meters."

MORNING SESSION, JUNE 8

The first business of the Thursday morning session was the adoption of an amended constitution.

This was followed by the election of officers, as follows:

PRESIDENT

A. D. Spencer, Central Heating Co., Detroit, Mich.

FIRST VICE-PRESIDENT

Warren Partridge, Springfield (Ill.) Light, Heat & Power Co.

SECOND VICE-PRESIDENT

R. D. DeWolf, Rochester (N. Y.) Railway and Light Co.

THIRD VICE-PRESIDENT

Cadwallader Evans, Jr., Oliver Power and Heating Co., Pittsburg.

SECRETARY-TREASURER

D. L. Gaskill, Greenville, O.

MEMBERS OF EXECUTIVE COMMITTEE

E. J. Kiefer, Halcyon Electric Light and Power Co., South Bethlehem, Pa.; J. L. Hecht, North Shore Electric Co., Chicago.

A paper was then read by R. D. DeWolf, of the Rochester (N. Y.) Railway and Light Co., on "The Preparation of a Rational Rate System." This was followed by a paper by W. E. Dowd, Jr., manager of the Philadelphia branch of the Power Specialty Co., on "Superheated Steam." Both of those papers aroused extended discussions.

AFTERNOON SESSION, JUNE 8

The last session was taken up with a report of the Committee on Radiation, followed by two papers on the same general subject, one by Walter J. Kline, of the American District Steam Co., Lockport, N. Y., on "Best Systems of Radiation for Economy and Steam Consumption When Fed from a District Heating Station," and the other by A. C. Rogers, of the Toledo (O.) Railways and Light Co., on the same for hot water.

On motion the Committee on Radiation was continued.

NEW COMMITTEES

On motion of Secretary-Treasurer Gaskill two new standing committees were provided for to take the place of the Committee on Rates. These are a committee of two on rates and a committee of two on uniform station records and accounting. It was also voted to have a committee of two to be appointed by the new president, to select an emblem for the association.

A further motion made by Secretary Gaskill was adopted providing for a standing committee on membership, to consist of seven associate members, the point being made that by making up the committee from those who did more or less traveling, increased opportunities would be presented for adding to the association's membership. The committee on meters was ordered to be continued, to report next year.

President Wright suggested that at the next convention a question box be provided to be opened during the convention. The suggestion will be taken up by the incoming executive committee.

Following resolutions of thanks to the entertainment committee and to the retiring officers, the incoming president took the chair. The new president, Mr. Spencer, expressed his appreciation of the hon-

or that had been bestowed upon him and pledged his best efforts to the further upbuilding of the Association.

The meeting then adjourned.

The Entertainment

A series of entertainment features whiled away the leisure time of the members and guests most delightfully. On Tuesday morning, the opening day of the convention, a trip was made to the pickling works of the H. J. Heinz Co., in Pittsburg. The visitors were entertained at luncheon and every courtesy was extended them to inspect the home of the "57 varieties." In the evening the members were entertained at the Grand Opera House, where they witnessed "A Man's World."

Wednesday morning the ladies were taken in automobiles to Carnegie Institute, followed by a ride through the parks and residential section of Pittsburg. In the afternoon the entire party went by train to the works of the Westinghouse Electric and Mfg. Co., in East Pittsburg, and spent a most enjoyable afternoon in inspecting this mammoth plant. The excursion was in charge of J. C. McQuiston, manager of the publication and publicity departments of the Westinghouse Companies, and the party was treated royally, being taken out to the works at East Pittsburg in a special car. On the return to the city many availed themselves of the invitation extended to visit Pittsburg's Natatorium and enjoy a plunge.

After the extended walk in connection with the inspection of the Westinghouse works, the dip in the Natatorium's large swimming tank was more than refreshing and put the finishing touch on an afternoon full of pleasure and interest.

In the evening the entire party were the guests of the Pittsburg Entertainment Committee, at a reception and smoker on the roof of the Oliver Building. The roof was transformed into a roof garden and was decorated with Chinese lanterns. On a special platform a negro quartette rendered a programme of songs, while at another point on the roof the Westinghouse Orchestra played at intervals throughout the evening.

Seated at small tables the party listened to the music, while a light luncheon, with cigars and cigarettes, was served.

Acting for the entertainment committee, Chairman George R. Folds, Pittsburg manager for the H. W. Johns-Manville Co., expressed the pleasure felt by the committee in entertaining the National District Heating Association. The sentiment was warmly responded to by President G. W. Wright and by Secretary-Treasurer D. L. Gaskill, both of whom voiced the feelings of the entire membership when they stated that the committee had outdone itself in the pleasure it had afforded to all through its generosity. The expressions of thanks which they voiced were encored with a will by the entire company.

Many stayed over after the convention to accept the invitation of the National Tube Co. to visit its steel works Friday morning.

MEMBERS AND GUESTS OF NATIONAL DISTRICT HEATING ASSOCIATION AT PLANT OF THE H. J. HEINZ CO., PITTSBURG.

Members and Guests

Geo. W. Wright, Baltimore Refrigerating and Heating Co., Baltimore.

D. L. Gaskill, secretary-treasurer, Greenville, O.

G. S. Morris, General Electric Co., Schenectady, N. Y.

A. E. Bettis, Kansas City Heating Co., Kansas City, Mo.

J. O. Klingelhofer, American Foundry and Construction Co., Pittsburg.

E. B. Tyler, Tyler Underground Heating System, Pittsburg.

Joseph Graham, *Engineering Review*, New York.

Thomas A. Donkin, Allegheny County Steam Co., Pittsburg.

J. C. McQuiston, Westinghouse Electric and Mfg. Co., Pittsburg.

John Hyde, City Light, Heat and Power Co., Pittsburg.

E. E. Ganss, Robbins Electric Co., Pittsburg.

C. Phillips Hill, Doubleday-Hill Electric Co., Pittsburg.

Geo. W. Provost, Union Electric Co., Pittsburg.

G. R. Folds, H. W. Johns-Manville Co., Pittsburg.

F. R. Low, *Power*, New York.

Mrs. F. R. Low, New York.

W. D. Shaler, Doubleday-Hill Electric Co., Pittsburg.

Cadwallader Evans, Jr., Estate of Henry W. Oliver, Pittsburg.

W. B. Wilkinson, Westinghouse Electric and Mfg. Co., Pittsburg.

J. D. Hiles, Best Mfg. Co., Pittsburg.

Mrs. W. B. Wilkinson, Pittsburg.

E. M. Decher, American Radiator Co., Pittsburg.

E. H. Eggleston, Jr., American Radiator Co., Pittsburg.

Van A. Reed, Jr., Federal Engineering Co., Pittsburg.

L. C. Frohrieb, Federal Engineering Co., Pittsburg.

J. P. Bordley, Central Station Steam Co., Detroit, Mich.

D. A. Gaskill, Green Electric Light and Power Co., Greenville, O.

J. T. Bulkley, Jenkins Bros., Pittsburg.

Henry B. Smith, Jr., Michigan Pipe Co., Bay City, Mich.

Harvey E. Smith, Terre Haute I. & E. T. Co., Terre Haute, Ind.

E. J. Kiefer, Halcyon E. L. & P. Co., Easton Pa.

A. C. Rogers, Toledo Railways and Light Co., Toledo, O.

A. H. Lamond, Michigan Power Co., Lansing, Mich.

A. D. Spencer, Central Heating Co., Detroit, Mich.

R. D. DeWolf, Rochester Railway and Light Co., Rochester, N. Y.

C. H. Spichler, Dayton Lighting Co., Dayton, O.

M. K. Zimmerman, Domestic Engineering, East Liverpool, O.

Warren Partridge, Springfield Light, Heat and Power Co., Springfield, Ill.

Grant Miller, Citizens' Lighting and Heating Co., Toledo, O.

S. C. Garner, Hazleton Steam Heating Co., Hazleton, Pa.

J. S. Wise, Jr., Hazleton Steam Heating Co., Hazleton, Pa.

F. C. Chambers, Springfield L., H. & P. Co., Springfield, Ill.

F. W. Wetherell, Peoria Gas and Electric Co., Peoria, Ill.

Harry G. Glass, Westinghouse Electric and Mfg. Co., Pittsburg.

E. A. Knowlton, Schutte & Koerting Co., Pittsburg.

J. V. Redfield, Central Station Steam Co., Detroit, Mich.

James A. Donnelly, Positive Differential System Co., New York.

Mrs. James A. Donnelly, New York.

C. H. Staten, H. W. Johns-Manville Co., New York.

J. S. Hecht, North Shore Electric Co., Chicago.

Frank N. Chew, *The Metal Worker*, New York.

P. J. Morrissey, Central Heating Co., Detroit, Mich.

W. J. Kline, American District Steam Co., Lockport, N. Y.

Robert Hall, American District Steam Co., Lockport, N. Y.

W. H. Schott, W. H. Schott Co., Chicago.

Robert G. Stewart, Tyler Underground Heating Systems, Pittsburg.

E. L. Barnes, American District Heating Co., Chicago.

Chas. T. Klingelhofer, American Foundry and Construction Co., Pittsburg.

Geo. N. Riley, National Tube Co., Pittsburg.

J. J. Kennedy, National Tube Co., Pittsburg.

Lee Phillips, Tyler Underground Heating Systems, Pittsburg.

A. S. Armagnac, The Heating and Ventilating Magazine, New York.

L. D. West, Cuyahoga Light Co., Cleveland, O.

J. C. Murdock, Strong-Carlisle-Hammond Co., Cleveland, O.

Edwin D. Dreyfus, Westinghouse Machine Co., Pittsburg.

F. H. Caldwell, *Electrical World*, New York.

W. M. Roberts, Jr., Edison Electric Illuminating Co., Cumberland, Md.

J. N. Reeves, Rex Mfg. Co., Johnstown, Pa.

M. F. Strouse, Industrial Engineering Co., Pittsburg.

Wm. Jennings, Steam Heating and Power Co., Harrisburg, Pa.

H. B. Law, Steam Heating and Power Co., Harrisburg, Pa.

L. A. Cramer, Steam Heating and Power Co., Harrisburg, Pa.

W. A. Wolls, Columbus Railway and Light Co., Columbus, O.

H. E. Haller, National Valve and Mfg. Co., Pittsburg.

John D. Walsh, American District Steam Co., Lockport, N. Y.

M. O. Payne, W. H. Schott Co., Chicago.

John R. Allen, University of Michigan, Ann Arbor, Mich.

Paul Mueller, Erie Co., Erie, Pa.

Davis S. Boyden, Edison Electric Illuminating Co., Boston.

Mrs. Edward Gliner, Somerville, Mass.

F. B. Dunlop, Bhom Railway, Light and Power Co., Bohm, Ala.

Geo. H. Criss, Westinghouse Electric and Mfg. Co., Pittsburg, Pa.

J. W. Rudin, Westinghouse Electric and Mfg. Co., Pittsburg.

C. G. Richardson, Builders' Iron Foundry, Providence, R. I.

Thos. H. White, Tri-State News Bureau, Pittsburg.

S. A. Fletcher, Westinghouse Electric and Mfg. Co., Pittsburg.

W. J. Grambs, Seattle Electric Co., Seattle, Wash.

G. E. Quinlan, Seattle Electric Co., Seattle, Wash.

C. L. Strong, Cleveland Steam Trap and Specialty Co., Cleveland, O.

Geo. Hartman, James J. Walker Co., Pittsburg.

Daniel L. Diedrich, James J. Walker Co., Pittsburg.

P. W. Butler, H. W. Johns-Manville Co., Pittsburg.

W. C. Craig, H. W. Johns-Manville Co., Pittsburg.

D. J. Fike, Meyersdale E. L., H. & P. Co., Meyersdale, Pa.

H. H. Lint, Meyersdale E. L., H. & P. Co., Meyersdale, Pa.

F. H. Dimock, Westinghouse Electric and Mfg. Co., Pittsburg.

E. M. Bendure, Central Station Heating Co., Buffalo, N. Y.

W. E. Dowd, Jr., Power Specialty Co., Philadelphia, Pa.

George D. Higgins, Murphy Heating Co., Detroit, Mich.

R. S. Edwards, Union Electric Co., Pittsburg.

D. Hunter, Jr., Underfeed Stoker Co. of America, Pittsburg.

Charles R. Bishop, American District Steam Co., Lockport, N. Y.

Among the Exhibitors at the District Heating Convention

Jenkins Bros., New York, had an interesting display of their line of valves and packings, including globe, angle, check, gate and radiator valves. J. T. Bulkeley, the company's Pittsburg representative, was in charge.

Michigan Pipe Co., Bay City, Mich., showed samples of its low pressure and high pressure steam pipe casings. Henry B. Smith, Jr., was on hand for the company.

General Electric Co., Syracuse, N. Y., had models of its steam, air and water flow meters, which attracted much attention. The company's interests were looked after by Glen S. Morris.

Westinghouse Electric and Mfg. Co., Pittsburg, Pa., had a display of its electric portables. The company had a big delegation on hand, headed by J. C. McQuiston, manager of the publication and publicity departments, and including H. G. Glass, G. H. Criss, W. P. Jand, W. B. Wilkinson, Edwin D. Dreyfus and H. C. Fletcher.

H. W. Johns-Manville Co., New York, had an elaborate exhibition of its line of asbestos products, also a life-sized model of its tile pipe conduit set in gravel. The company was represented by George R. Folds, manager of the Pittsburg branch; C. H. Staten, W. C. Craig and P. W. Butler.

American District Steam Co., Lockport, N. Y., displayed a model of its system of district heating, together with models of many of its other products, including atmospheric heating devices, expansion joints, etc. Charles R. Bishop, secretary, and Robert E. Hall, treasurer; W. J. Kline and E. L. Barnes were on hand in the interests of the company.

American Foundry and Construction Co., Pittsburg, Pa., exhibited a model of the Crescent patent steam pipe conduit, showing especially the sections of the manholes and anchor boxes and also a section through the conduit. Additional exhibits were samples of their high pressure steam piping equipment, together with miscellaneous Crescent apparatus, the Crescent patents being controlled by W. H. Pearce & Co., Chicago. The company was represented by W. L. Klingelhofer, president; J. O. Klingelhofer, secretary and treasurer; C. T. Klingelhofer, superintendent; J. B. Robertson, manager of sales, and Oliver J. Haller, chief engineer.

Best Mfg. Co., Pittsburg, displayed catalogues of its Tuyere cocks and unions, flanged pipe joints, flanged fittings and flanges, flexible joints, exhaust relief and back pressure valves, Gulland stand-pipe and automatic valves. Among the company's representatives on hand were J. D. Hiles, manager of sales; W. J. Prenter, William Latshaw.

Central Station Steam Co., Detroit, Mich., showed types of its gravity rotating condensation meter, also a full line of its diaphragm expansion joints. Another feature of the company's exhibit were sections of the Ric-Wil system of underground pipe covering, for which the company is selling agent. The company was represented by W. V. Redfield, president, and J. V. Bordley.

International Heating and Ventilating Congress

The programme has been received of the Eighth International Congress of Heating and Ventilating Engineers which is being held this month (June 12-14) in Dresden, Germany. Taken in connection with the International Health Exhibition in the same city from May to October, the congress promises to be the most important affair of its kind that has ever been held. A special section of the exhibition is being devoted to heating and ventilating appliances. The programme in detail is as follows:

MONDAY, JUNE 12

Forenoon: First meeting in the aula of the Royal Technical High School, Dresden.

Afternoon: Inspection of Heating and Ventilating Plants. The following buildings have been taken in view: Municipal Offices (Staendehaus), County Court and Prison, Town Hall and Slaughter House.

TUESDAY, JUNE 13

Forenoon: Second meeting in the auditorium of the International Hygiene Exhibition. Report on the exhibition itself, and on the scientific section of the exhibition, ventilating, heating, and collective exhibition of the Union of German Central Heating Engineers. Inspection of the exhibition under the guidance of experts.

WEDNESDAY, JUNE 14

Forenoon: Third meeting in the aula of the Royal Technical High School, Dresden.

Afternoon: Inspection of heating and ventilating plants.

The following lectures will be given at the various professional meetings:

1 Far distance heating;
2 Heating of Schools;
3 Hot Water Supply Plants;
4 Historical development of the science of heating;
5 Reports on hygiene exhibition at Dresden in 1911, and on the special exhibition of heating and ventilating appliances.

The arrangements of the congress are in charge of Dr. Otto Krebs, of Mannheim.

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IF no direct results are to be noted in the journey of the Master Fitters' National Association to the West, the event has, at least, served to clarify the status and viewpoints of both Eastern and Western steam and hot water fitting contractors. The East has had a valuable object lesson presented to it in the shape of prosperous and enthusiastic local master fitters' organizations working individually, it is true, but solving their problems and meeting their situations on the spot, with strict reference to the needs and requirements of their immediate locality. This may not be a broad-minded trade policy, but it serves the immediate purpose and is preferred to the wider, and possibly less definite, activities of a national organization, especially one whose center is and has been for so long in the East.

On the other hand, the evident cordiality displayed by the Western contractors towards their Eastern friends was not to be mistaken. It was plain that no vestige remained of any feeling due to events of by-gone years and the interest they displayed in the convention itself was amply attested to by the large number of Western faces that were to be seen in the convention hall and about convention headquarters.

The national association may well congratulate itself on having gone to Chicago for its 1911 convention. It has more friends in the West than it had before, and, one may hope, it now appreciates more thoroughly the difficulties that lie in the way of a broad organizing movement in that direction. If it does, and would rise to the occasion with a master stroke, let New York be eliminated for a time as national headquarters.

OF quite another character was the convention of the district heating engineers in Pittsburg. This organization is still in the flush of youth, a characteristic that was reflected in the number and quality of the papers presented, and the attention with which the discussions were followed. Our readers will be favored with the most important of these papers, from a heating and ventilating standpoint, as space permits. This young organization continues to show every sign of vigorous life and undoubtedly has a brilliant future before it.

AS usual during the summer months, we will omit the publication of the monthly weather charts for five representative American cities, which have been published in this magazine during the past heating seasons. In the Fall we shall resume the publication of these charts, which will mark the sixth year of their appearance in our columns.

Central Station Heating

3.—"READY TO SERVE" OR "MAXIMUM DEMAND" RATE

By Byron T. Gifford

(Previous articles in this series: "Pipe Line Losses," April, 1911; "Rates," May, 1911.)

THIS method of charge is finding universal favor in connection with public utility service, and is, without a doubt, the most scientific of any method of charge. It is based upon the exact cost of giving service, plus an equitable profit, and the consumer pays for the service in exact proportion to the service he receives.

It has often been said that a public service company should have but one rate to each and every one of its consumers, and from this principle the flat-rate charge was established. The first flat-rate method of charge was based on the cubic foot of contents of the building as a unit. It soon developed that this was not an equitable basis and it was then modified by making different rates for buildings used for different purposes.

The next step toward equitable rates was the charge based on the square foot of radiation as a unit, under the assumption that each square foot of radiation would give off the same number of heat units, but it developed that this assumption is not true, because under different conditions a square foot of radiation will give off a decidedly different number of heat units per square foot, ranging from 300,000 B. T. U. per season to 1,400,000 B. T. U. per season. This method was somewhat improved by charging a given price per square foot of radiation required and used in connection with thermostatic control to regulate the temperature of the buildings heated. This arrangement works out admirably except that it is apt to develop a tendency of carelessness in the consumer, as any flat rate is apt to do.

The meter basis of charge has been instituted and the charge based on the heat consumed, with the condensed steam used as a basis of charge and with 1000 lbs. of condensed steam as a unit. This method of charge seemed for a time to fill the place of an equitable rate, especially with the sliding scale of prices per 1000 lbs., but this method has developed its faults also.

For example: assume a building that uses heat only six hours out of the twenty-four hours in a day. This building demands a place on the line and requires the capacity, both in the mains and at the heating station, to supply its maximum demand. The heating company must be ready to serve this building at any time it requires service. In return for that required condition, the heating company only receives pay for six hours' service, while the building using heat for eighteen

hours pays the company three times the revenue paid by the other building.

It is also the case with churches or auditoriums where heat is used only two or three days out of the week. The heating company must reserve capacities for these buildings, but in return only receives about one-sixth the revenue it would receive from other buildings requiring the capacities that these churches, etc., require. It is obvious, therefore, that a rate based on the number of pounds of steam condensed is far from equitable.

It is here that the "maximum demand" or "ready to serve" rate shows its strong points as an equitable rate. As stated before, this rate is based on the cost of the service to the utility, plus an equitable profit.

We will take for granted that it costs $200,000 to install a non-byproduct heating plant to serve a given territory. In this territory there is available business amounting to 20,000,000 cu. ft. of space, which, for steam heating, will require approximately 200,000 sq. ft. of radiation.

The cost of operating this system is divided into two parts: (1) Fixed charges, such as interest, depreciation, distribution costs and mantenance; (2) generating costs, such as coal, water, power-house labor, and other items that vary with the amount of steam generated.

The generating costs in the plant would probably be as shown below, but this item would change materially, depending upon the cost of fuel, labor and water. We will, however, assume values here so as to more clearly explain the example.

With 200,000 sq. ft. of radiation connected, averaging 600 lbs. of steam per square foot per season, we would have 120,000,000 lbs. of steam to generate. We can also assume 1 lb. of coal will evaporate 5 lbs. of water into steam, and that this coal will cost $2.00 per ton on the plant's siding:

Coal

120,000,000 lbs. ÷ 5 = 24,000,000 lbs. coal.

12,000 tons coal @ $2.00 = $24,000.00 = 20c per 1000 lbs. steam.

Labor

The labor in this plant would cost about as follows:

1 Chief Engineer	$1,200.00
1 Assistant Engineer ...	900.00
6 Firemen (9 months) ...	3,240.00
	$5,340.00 = 4.5c per 1000 lbs. steam.

General Expense

Repairs, renewals and supplies....................	$600.00
One-half office expenses	1,460.00
One-half incidental expenses	500.00
	$2,560.00

Water

Water @ 5c per 1000 gals. (15,00,000) = $750.00.

Recapitulation of Generating Costs

Coal	$24,000.00
Labor	5,340.00
General expense	2,560.00
Water	750.00
	$32,650.00 = 27c per 1000 lbs. steam generated.

The fixed charges on a plant of this kind would be approximately as follows:

Interest—	
6% on $200,000.00	$12,000.00
Taxes and Insurance—	
1½% on $200,000.00	3,000.00
Depreciation—	
3% on $200,000.00	6,000.00
Maintenance—	
Estimated	1,000.00
Distribution Costs—	
One-half office expense	1,460.00
Officers' salaries	5,400,00
One-half incidental expenses	500.00
Line loss	4,334.00
	$33,694.00

The line loss is figured at the rate of 0.050 lb. steam per square foot of pipe-line surface, per hour, based upon the following line:

Diameter in inches.	Sq. ft. of surface in the pipe line and fittings.
16	7,961
12	11,700
10	14,612
8	11,070
6	10,847
5	2,482
4	3,068
	61,740

61,740 × 0.050 = 3087 lbs. steam per hour.

5,200 hours = 16,052,400 lbs. @ 27c per 1000 lbs. = $4,334.00.

With a fixed charge of $33,694.00 per season to distribute heat to 200,000 sq. ft. of radiation it is seen that it costs 16.84c per square foot to distribute the heat. We have also determined that it costs, under the assumed conditions, 27c to gen-

erate 1000 lbs. of steam. We know now what our costs are and in order to determine our selling rate we must add our profit, which should be reasonable.

It is generally conceded that 10% is an equitable income on the money invested, and, that being the case, we have 4% on $200,000.00 to add as profit (6% has already been accounted for under interest). 4% on $200,000 = $8,000.00. This item can be charged, either all to fixed charges or one-half to fixed charges and one-half to generating. The author prefers the latter scheme.

This profit added brings our fixed or service charge up to $37,694.00 per season, and this is equal to 18.84c or 19c per square foot per season. Our rate for steam used would also be increased to $36,650.00 for 120,000,000 lbs., which equals 30½c per 1000 lbs.

Under the conditions above noted, a non-byproduct plant should charge a service rate of 19c per square foot and a meter rate of at least 30c per 1000 lbs. of condensation.

In a byproduct plant the rate to be charged is figured the same way as the above.

The service charge should be paid by the consumer as any flat rate is paid, in installments either monthly or quarterly.

Mr. Gifford's next article will appear in the July issue.

Ventilation Law for North Dakota

In an act approved March 6, 1911, North Dakota has added its name to the ranks of the compulsory-ventilation-law states.

The bill was introduced by Mr. Price in the House, and was designed to govern the construction of public-school buildings and to provide for the inspection, ventilation and sanitation thereof. The full text of the act is as follows:

"Section 1. No building which is designed to be used, in whole or in part, as a public-school building, shall be erected until a copy of the plans thereof has been submitted to the State Superintendent of Public Instruction, who for the purposes of carrying out the provisions of this act is hereby designated as inspector of said public-school building plans and specifications, by the person causing its erection by the architect thereof; such plans shall include the method of ventilation provided therefor, and a copy of the specifications therefor.

"Sec. 2. Such plans and specifications shall show in detail the ventilation, heating and lighting of such building. The State Superintendent of Public Instruction shall not approve any plans for the erection of any school building or addition thereto unless the same shall provide at least 12 sq. ft. of floor space and 200 cu. ft. of air space for each pupil to be accommodated in each study or recitation room therein.

"1. Light shall be admitted from the left or from the left and rear of class-rooms and the total light area must, unless strengthened by the use of reflecting lenses, be equal to at least 20% of the floor space.

"2. All ceilings shall be at least 12 ft. in height.

"3. No such plans shall be approved by him unless provision is made therein for assuring at least 30 cu. ft. of pure air every minute per pupil and warmed to maintain an average temperature of 70° F. during the coldest weather, and the facilities for exhausting the foul or vitiated air therein shall be positive and independent of atmospheric changes. No tax voted by a district meeting or other competent authority in any such city, village, or school district, exceeding the sum of $2000.00 shall be levied by the trustees until the State Superintendent of Public Instruction shall certify that he plans and specifications for the same

comply with the provisions of this act. All school houses for which plans and detailed specifications shall be filed and approved, as required by this act, shall have all halls, doors, stairways, seats, passageways and aisles and all lighting and heating appliances and apparatus arranged to facilitate egress in case of fire or accident and to afford the requisite and proper accommodations for public protection in such cases. All exit doors shall open outwardly, and shall, if double doors be used, fasten with movable bolts operated simultaneously by one handle from the inner face of the door. No staircase shall be constructed with wider steps in lieu of a platform, but shall be constructed with straight runs, changes in direction being made by platform. No doors shall open immediately upon a flight of stairs, but a landing at least the width of the door shall be provided between such stairs and such doorway.

"4. Every public school building shall be kept clean and free from affluvia arising from any drain, privy or nuisance, and shall be provided with sufficient number of proper water closets, earth closets or privies, and shall be ventilated in such a manner that the air shall not become so impure as to be injurious to health.

"Sec. 3. No toilet room shall be constructed in any public-school building unless same has outside ventilation and windows permitting free access of air and light. The provisions of this act shall be inforced by the State Superintendent of Public Instruction or some person designated by him for that purpose.

"Sec. 4. If it appears to the State Superintendent of Public Instruction, or his deputy appointed for that particular purpose, that furher or different sanitary or ventilating provisions, which can be provided without unreasonable expense, are required in any public-school building, he may issue a written order to the proper person or authority, directing such sanitary or ventilating provisions to be provided. A school committee, public officer or person who has charge of any such public-school building, who neglects for four weeks to comply with the order of said State Superintendent of Public Instruction or his deputy shall be punished by a fine of not less than $100.00 nor more than $1000.00.

"1. Whoever is aggrieved by the order of the State Superintendent of Public Instruction or his deputy issued as above provided, and relating to a public-school building, may within thirty days after the service thereof apply in writing to the board of health of the city, town, incorporated village or school district to set aside or amend the order; and thereupon the board, after notice to all parties interested, shall give a hearing upon such order, and may alter, annul or affirm it.

"Sec. 5. No wooden flue or air duct for heating or ventilating purposes shall be placed in any building which is subject to the provisions of this act, and no pipe for conveying hot air or steam in such building shall be placed or remain within 1 in. of any woodwork, unless protected by suitable guards or casings of incombustible material.

"Sec. 6. To secure the approval of plans showing methods or systems of heating and ventilation as provided for in Section 2 the foregoing requirements must be guaranteed in the specifications accompanying the plans. Hereafter erections or constructions of public-school buildings by architect or other person who draws plans of specifications or superintends the erection of a public-school building, in violation of the provisions of this act, shall be punished by a fine of not less than $100.00 nor more than $1000.00.

"Sec. 7. All acts or parts of acts in conflict herewith are hereby repealed.

"Sec. 8. Whereas, there being no adequate law on the statute books governing the subject matter, therefore an emergency exists and this act shall be in force and effect from and after its passage and approval."

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Mid-Summer Meeting in Chicago, July 6-8

At a meeting of the Board of Governors, held May 27, it was decided to hold the semi-annual (mid-summer) meeting of the American Society of Heating and Ventilating Engineers in Chicago, July 6-8, 1911. Headquarters will be at the La Salle Hotel.

Committee Appointments

Announcement has been made by Secretary W. W. Macon of the following committees to carry on the work of the Society during the present year:

STANDARDS

J. J. Blackmore (chairman). Ralph Collamore, Roy E. Lynd, E. A. May, P. H. Seward.

TESTS

W. H. McKiever (chairman). F. T. Chapman J. A. Donnelly, N. S. Thompson, M. F. Thomas.

HEATING GUARANTEES

W. M. Mackay (chairman). Thomas Morrin, G. W. Scott, F. C. Goff, C. E. Pearce.

SCHOOLROOM VENTILATION

F. I. Cooper (chairman), C. B. J. Snyder, E. D. Densmore, C. F. Eveleth, H. W. Whitten.

AIR LEAKAGE AND VENTILATION OF THE CLOSED ROOM

Prof. J. H. Kinealy, general chairman.

Massachusetts: H. W. Whitten (chairman), R. L. Folsom, D. S. Boyden, Charles Morrison, L. G. Robbins.

Pennsylvania: I. H. Francis, Jr. (chairman), Homer Addams, E. S. Berry, J. E. McGinness, J. P. Schaffer.

Missouri: B. C. Davis (chairman), H. H. Humphrey, J. M. Kent, F. N. Jewett, Samuel Kauffman.

REVISION OF THE CONSTITUTION

Prof. Wm. Kent (chairman), Prof. R. C. Carpenter, W. G. Snow, S. A. Jellett, F. K. Chew.

Committees on compulsory ventilation are also at work in Massachusetts, New York, Maryland, Illinois, Indiana and Tennessee.

Legal Decisions

Guaranty of Steam Plant—Change in Contract

A contract for the construction of buildings contained certain guarantees by the contractor, including a guarantee of the steam plant and its appurtenances to be in first-class working order and condition, and to supply the heat mentioned in the specifications for the term of one year from a certain date. Certain disputes having arisen between the parties, a second agreement was entered into, reciting the settlement of the disputes and the payment by the owner of a sum for his discharge under the first contract. The agreement also stipulated for the delivery of certain specified guarantees by the contractor to the owner. It was held that the guarantees of the first contract were not discharged by the second agreement. The contractor remained liable thereunder until he had delivered the guarantees required by the second agreement.—Cohan vs. Rosenberg, New York Supreme Court, Appellate Term.

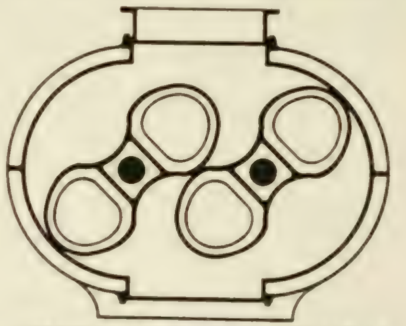
NEW DEVICES

Rotary Vacuum Heating Pumps

The application of a rotary cycloidal pump to the field of vacuum heating engineering is an interesting development of the Connersville Blower Co.'s high vacuum pump. The first pumps designed by this company were used in connection with jet condensers for steam turbines, where a vacuum within 2 in. of the barometer is required. The same standard of design, workmanship and material which made these pumps successful for condenser work, has been applied in developing a line suitable for the vacuum heating trade.

This pump has no valve springs or small parts to get out of order, and has an opening inlet of large area, thus avoiding the resistances such as are encountered with piston pumps through the valve and ports. There are no clearance spaces, nor pockets in which the air and vapors can be compressed and re-expanded, and no internal parts requiring lubrication. The cross section through the cylinder shows the working parts. The impellers do not touch each other nor the surrounding case. The return water lying on top of the impeller forms a water seal, adding to the efficiency of the pump. The parts forming the frame are rigid, and all the bearings are ring oiling, a feature designed to reduce the care of oiling to a minimum.

A rotary pump, owing to the comparatively high speed at which it runs, is more suitable for electric drive than a piston pump; it is particularly well adapted for use in those buildings where all



SECTIONAL VIEW OF CONNERSVILLE PUMP

electric power is supplied from a central plant, and where a low pressure boiler carrying steam of ½ lb. to 1 lb. pressure could be used if steam of a higher pressure for operating the vacuum pump was not required. Also in plants where the firing of the boilers is irregular the use of an electric driven pump is a distinct advantage, as it will maintain the circulation as long as any steam is available, regardless of the pressure. This pump serves both as an air and a water pump, and will return the water of condensation direct to boiler, doing away with the feed pump.

It will operate successfully with very hot water, and maintain a corresponding vacuum. This is not true of a piston pump, because the vacuum in the cylinder is necessarily higher than the vacuum outside the valves, due to the resistance of the valves and ports, and due to overcoming the inertia of the water when the piston starts, and is coming up to full speed. In piston pumps when the

vacuum carried is near to that corresponding to the temperature of the water, the higher vacuum inside the pump cylinder causes a re-evaporation of the water in the cylinder, under which condition no outside work will be done and the pump will race. It is found that these pumps require less power than a piston pump, and cost considerably less for up-keep.

They are made in a wide range of sizes for displacements from 40 gals. per min. to 10,000 gals. per min., and can be secured from any of the vacuum heating companies, or steam fitting contractors. The same type pump can also be used for house pumps, etc.

A Steam Turbine for Driving Direct-Current Generators and Other Low or Moderate Speed Machinery

Steam turbine builders are making many modifications of type just now, all, or nearly all, of which are steps in the direction of reconciling the high velocity of the steam turbine bucket with the more moderate speed at which the driven machine, such as direct-current generator, fan, pump, etc., should properly run.

The accompanying description of a direct-current turbo-generator exemplifies a method by which it is possible to retain the advantages in the way of efficiency, low cost and simplicity inherent in the use of high bucket speeds with the practical and theoretical benefits of low speeds in the generator or other driven machine.

This compromise is by the use of helical gears, which were first applied to turbines of moderate size over twenty years ago by DeLaval and which, during the last four years, have been developed for application to large size turbines, including the perfection of special methods of building, etc., whereby highly efficient, silent and durable gears are obtained.

Speaking generally, the large size steam turbine has so far found application only for the driving of alternators and the propulsion of ships. Little progress, comparatively, has been made in its adaptation for driving direct-current generators, and for direct connection to other machinery of moderate speed, such as centrifugal pumps and blowers, or for the driving of machinery by means of ropes or belts. While the suitability of the turbine for these purposes, because of its simplicity, small weight and space requirements, good steam economy and in recent years lower price, is apparent, the engineering world has, nevertheless, awaited the practical solution of the problem of driving such machines by steam turbines.

The nature of the difficulty is, at once, apparent, from a simple statement of the velocities, etc., involved. The expansion of one pound of steam from 150 lbs. pressure (164.7 lbs. absolute) to a 28-inch vacuum renders available for conversion into work 325 B. T. U., equal to 252,850 foot pounds of energy. If the expansion be accomplished in one nozzle having unit efficiency, the resulting velocity of the steam will be 4040 ft. per second.

In view of the pressing nature of the speed-reduction problem, the turbo-generator described herewith possesses considerable theoretical and practical interest.

The unit shown in Fig. 1 consists of a multi-stage turbine driving a standard speed, direct-current Crocker-Wheeler generator through a pinion and single gear, the speed of the turbine shaft being 3600 R. P. M. and the speed of the generator shaft 500 R. P. M. The photograph will give a good idea of the compact nature of the construction of a turbine, the maximum capacity of which is 1200 H. P.

Steam is admitted to the turbine first through a strainer case and then through a combined trip and throttle valve, to be seen at the extreme right; next through the adjacent governor valve and then, after passing through steam nozzles of the standard DeLaval type, impinges upon the blades of the

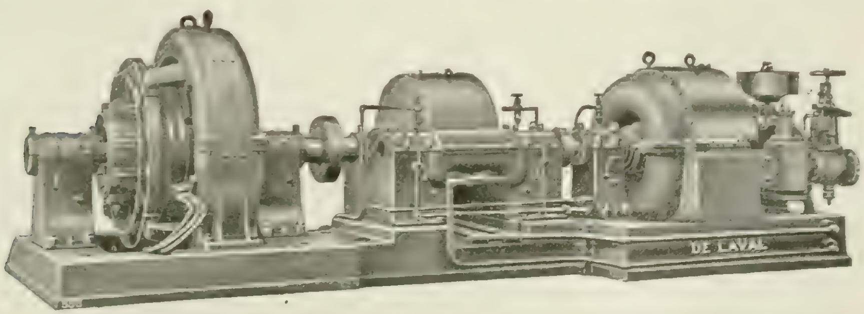


FIG. 1—DE LAVAL MULTI-STAGE SINGLE-GEARED STEAM TURBINE, DRIVING CROCKER-WHEELER DIRECT-CURRENT GENERATOR. CAPACITY 500 KW. SPEED 500 R.P.M. HIGH PRESSURE TYPE

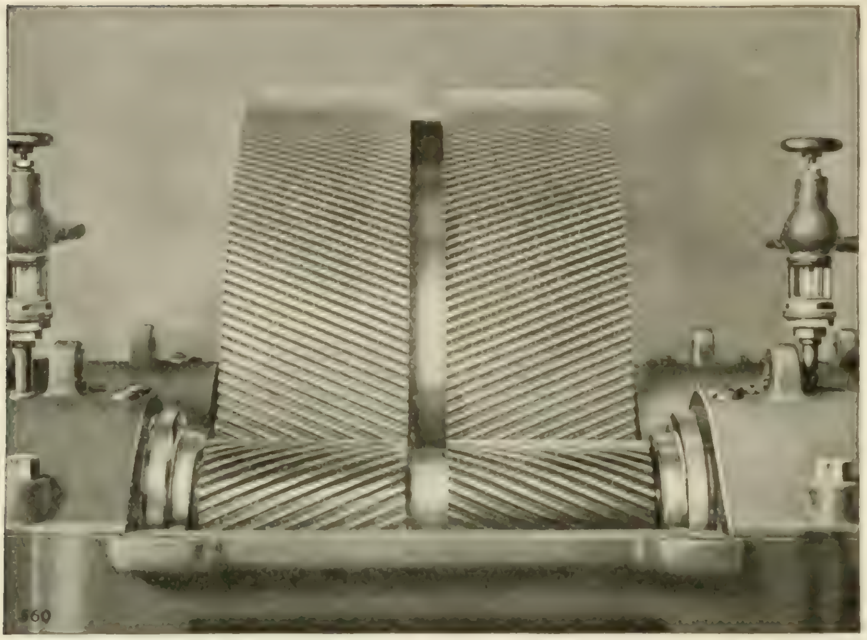


FIG. 2—GEAR AND PINION OF THE DE LAVAL MULTI-STAGE, SINGLE-GEARED TURBINE IN PLACE IN GEAR CASE

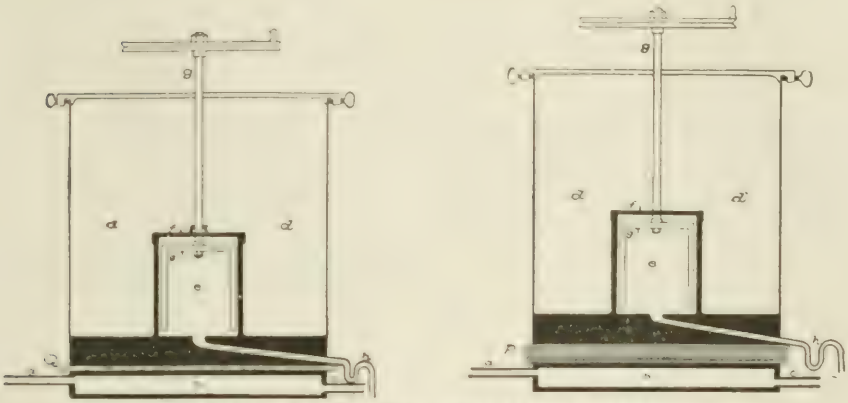
first-stage wheel. Partial admission is used in the first stage, but full admission in later stages. The wheels are of the standard DeLaval type, made of such section as to give great strength throughout. The buckets are set in the rim by a peculiar form of dovetail.

The pinion and gear, perhaps the most important and interesting part of the construction, is shown in Fig. 2. The gear consists of a solid cast-iron center upon which are shrunk two thick steel rings. The hub is mounted on a stiff shaft, which carries at one end a half of the flexible coupling for connection to the driven machine.

A New Heat Insulator and Sound Deadener

Cabot's "Quilt" is a new product, based on an old idea, for furnishing a scientific heat insulator and sound deadener. It is a felt matting of cured eel-grass stitched with strong thread, and laid between two layers of tough "Kraft" paper. It is used as a lining in houses, for deadening sound in floors and partitions, for insulating cold stores, refrigerators and ice houses. The eel-grass fibres are long and flat, and cross each other at every angle, making a thick, elastic cushion filled with dead air spaces. Eel-grass, the makers state, will not decay, will not harbor insects or vermin, is not inflammable and will not be eaten by rats or mice. This "quilt" is now furnished in the form of rolls in place of bales, the rolls eliminating the folds in the quilt and enabling it to be easily handled. It is made in six different grades.

CABOT'S "QUILT" FOR HEAT INSULATING AND SOUND DEADENING, SHOWING MATTING OF CURED EEL GRASS



APPARATUS FOR TESTING INSULATING MATERIALS

In a series of tests on this material, the apparatus shown in the accompanying illustrations was used. The test demonstrated that one layer of double-ply "quilt" was more efficient as a heat insulator than forty layers of building paper.

In these tests steam was used to give a uniform known high temperature, and ice to give a uniform known low temperature, so that exact results would be insured. Steam flows from pipe (a) to pan (b) and out at outlet (c). This produces the uniform high temperature under the material to be tested (P) or (Q); (d) is a chamber filled with broken ice, which surrounds the calorimeter (e) on all sides except the bottom, thus producing the uniform low temperature around the calorimeter, which is filled with fine cracked ice, is covered by a water-tight cover (f), and the ice is gently agitated with the stirrer (g). The ice in the calorimeter (e) is melted by the heat transmitted from the steam pan (b) through the insulating material (P) or (Q), and in no other way, as it is surrounded on all other sides by a freezing temperature. The melted ice from the calorimeter (e) flows out through the drip (h) and the amount of ice melted in the calorimeter (e) gives the efficiency of the insulating material.

Cabot's "Quilt" is made and sold by Samuel Cabot, Inc., Boston, Mass.

A 32-Ft. Fan For a Yarn Mill

One of the largest fans ever made is shown in the accompanying illustration. It is over 32 ft. high and was made by the Buffalo Forge Co., to be used in connection with a heating, ventilating and air conditioning system, supplying 25,000 cu. ft. of air per hour to the employees in the new mill of the Sharpe Mfg. Co., New Bedford, Mass., the largest individual yarn mill in that city.

In this mill particular consideration is given to the hygienic conditions of operation. The air is washed before entering the mill, all dust, dirt and foreign matter being removed. In winter the air is heated to any desired temperature, a feature being independent regulation on each floor. Provision is also made for cooling the air, so that in the hottest days of summer the temperature throughout the mill, even in the spinning room where machinery generates an immense

32 FT. FAN MADE BY THE BUFFALO FORGE CO. AND INSTALLED IN PLANT OF SHARPE MFG. CO., NEW BEDFORD, MASS.

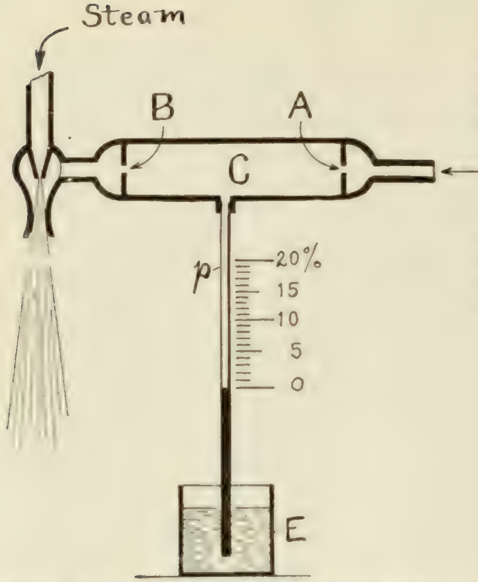


FIG. 1—SHOWING PRINCIPLE OF THE UEHLING WASTE METER FOR MEASURING PER CENT CARBON DIOXIDE OR TEMPERATURE.

amount of heat, is from 15° to 20° cooler than is possible by ordinary window ventilation.

The volume of air that the fan handles to achieve these results reaches the total of 20,000,000 cu. ft. per hour.

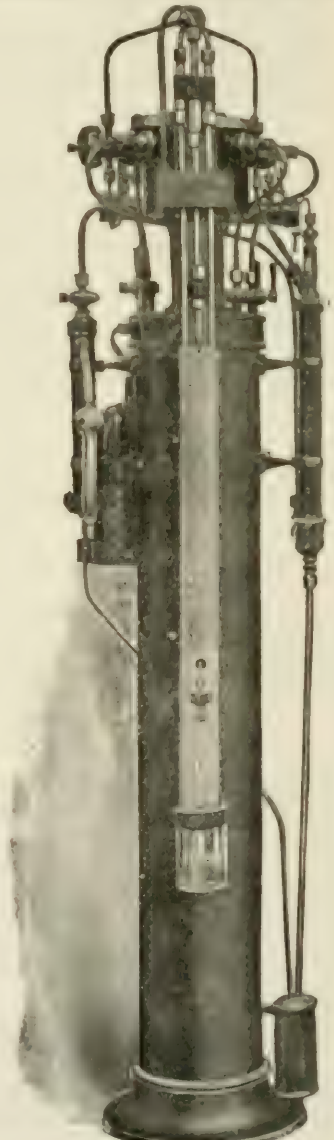
An Improved CO_2 Recorder.

On the average it may be stated that only 60% of the heat in the coal enters the boiler; 40% is wasted. Of this 40% the total waste is distributed about as follows: loss in radiation, 5%; loss in soot and smoke, 1%; loss represented by actual loss of coal through the grates, 2%; loss due to combustion of the carbon to carbon monoxide instead of dioxide, 2%; heat carried away by the chimney gases due to their temperature, 30%.

The relation between per cent. carbon dioxide and heat lost is shown diagramatically by the chart (Fig. 2). The areas in each case are proportional to the amount of heat wasted, and as these areas are reduced by decreasing the excess air the per cent. of CO_2, it will be noted, is increased.

The fact that caustic potash absorbs carbon dioxide is the fundamental principle of all instruments for making a measurement of CO_2. In the older types of automatic recording instruments, bells or jars for measuring the gases before and after the CO_2 was absorbed were used. The difference in volume of the gas before and after the CO_2 was abstracted gave a measurement of carbon dioxide in the gases.

If instead of measuring the per cent. carbon dioxide by measuring the actual volume of a given amount of gas before and after the carbon dioxide has been abstracted from it, the pressure of the gas is measured, then the change in pressure of the gas due to the reduction in its volume when the CO_2 is absorbed will give a ready and reliable method of measurement. By this means the record



THE UEHLING WASTE METER OR SINGLE COMBINED CARBON DIOXIDE AND TEMPERATURE MACHINE

may be made continuous, and indicating devices may be used in connection with the machine. The machine also gives for measuring both percentage of carbon dioxide and temperature. Gas is drawn through the apparatus continuously by a

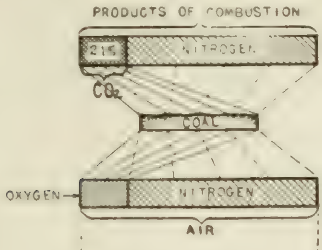


FIG. 2—CHART (a) SHOWING HOW WITH THE THEORETICAL SUPPLY OF AIR, THE PER CENT CO_2 IN THE PRODUCTS OF COMBUSTION IS THE SAME AS THE PER CENT OXYGEN IN THE AIR

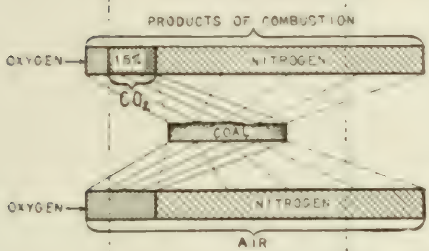


FIG. 2—CHART (b) SHOWING HOW IN EXCELLENT PRACTICAL COMBUSTION, WITH 40% EXCESS AIR THE PER CENT CO_2 IS 15.

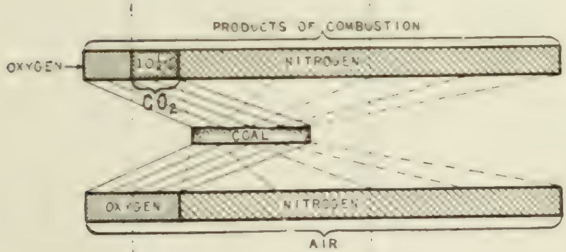


FIG. 2—CHART (c) WITH 100% EXCESS AIR, ONLY HALF THE OXYGEN IS USED AND THE PER CENT CO_2 IS ONE-HALF OF 21 OR 10½

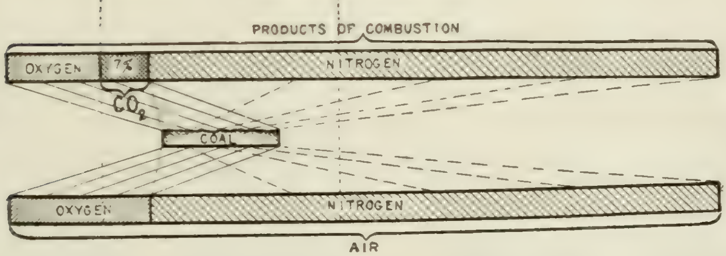


FIG. 2—CHART (d) WITH 200% EXCESS AIR, ONLY ONE-THIRD THE OXYGEN SUPPLIED IS NEEDED AND THE PER CENT OF CO_2 IS ONE-THIRD OF 21 OR 7

both carbon dioxide and temperature, which may be automatically recorded on charts at the most convenient points.

Fig. 2 shows how this principle is employed in the Uehling Waste Meter small steam aspirator. In chamber C the carbon dioxide is absorbed (in the case of the carbon dioxide instrument), and thus the volume of the gas between the apertures is reduced by an amount

depending upon the amount of CO_2 present. Any reduction in the volume of the gas between the two apertures increases the vacuum. These changes are proportional to the amount of CO_2 absorbed, and thus the suction or partial vacuum forms a basis for indicating and recording variations in carbon dioxide in flue gases.

The indicating instruments are simply columns properly calibrated and are supplied at the machine proper and also for the front of the boiler.

As the same principle and similar apparatus is used to measure temperature, a very effective combined CO_2 machine and temperature machine or waste meter may be built on this principle. In measuring temperatures, instead of the change in vacuum being produced by absorbing part of the gas between the apertures, change in vacuum is secured by reason of the difference in temperature between the two apertures. One aperture is in a nickel tube, placed in the flue or other part of the furnace, and the other maintained at a constant temperature by exhaust steam.

A Comprehensive Boiler and Radiator Catalogue

A handsome catalogue of unusual interest has lately been compiled by the United States Radiator Corporation and is now ready for distribution. New illustrations are shown of Improved United States Boilers, which include the Capitol sectional type and the Capitol Solar round boiler which were manufactured by the United States Heater Company, Detroit, Mich.; of the Furman sectional boiler and the Furman round boiler which were manufactured by The Herendeen Mfg. Co., Geneva, N. Y., and of the Sunray sectional type that were made by The J. L. Mott Iron Works, at West Newton, Pa.

What is stated to be the widest range in capacities ever offered by one manufacturer is included in the Complete Line, the steam boilers ranging in size from 250 sq. ft. to 8550 sq. ft., and the water boilers from 425 sq. ft. to 14,100 sq. ft. Each rating is guaranteed.

Six different patterns of United States radiators are presented including the Puritan plain pattern and the Florentine ornamental pattern formerly manufactured by the United States Heater Co., Detroit; the Triton plain, Triton ornamental pattern and the Triton Flue Radiator formerly manufactured by the United States Radiator Co., Dunkirk; the Sunray ornamental, the Grecian plain and the Utility pattern formerly made, along with Athenian wall pattern, at West Newton and Corry, Pa., plants by the J. L. Mott Iron Works and the United States Radiator and Boiler Co.

The company's line of radiator specialties includes corner, curved, oven and pantry radiators, with all such novelties as adjustable feet and high and low legs.

Besides a complete line of standard steam and hot-water valves, the company offers the the Triton packless radiator valve for steam; also the Triton packless radiator valve for hot water, which is stated to be the only packless hot-water valve on the market.

Air and vacuum valves of improved type, Capitol automatic draft regulators, radiator shields and foot rests and radiator trucks are also included among the company's specialties.

Toward the end of the catalogue are found a number of tables on heating subjects, such as chimney flues, heat measurement, etc. There are also given pages covering repair parts on all makes of boilers and tank heaters, and the necessary telegraph code.

Advertisers' Index

TRADE AND MISCELLANEOUS NOTES

Coming Event

July 6-8, 1911. Semi-annual meeting of The American Society of Heating and Ventilating Engineers, Chicago, Ill. Headquarters at the La Salle Hotel.

Miscellaneous Notes

United Heating and Power Association of Chicago is a new organization of master plumbers who are also engaged in the heating business. The members were formerly affiliated with the Chicago Steam Heating and Ventilating Engineers. The new body has organized with the following officers: President, John J. O'Shea; vice-president, H. P. Reger; treasurer, A. Nilson; secretary, J. J. Cahill; board of directors, above named officers and William Downs, A. W. Wells and C. E. [illegible]. The organization has started with a membership of 28 firms, including the following:

[illegible] Lake street, Oak Park, Ill.; [illegible] 6306 Lexington avenue; J. J. Cahill, 830 Hamlin street, [illegible]; J. H. Dause, 1615 Benson avenue, Evanston, Ill.; Wm. Downs, 4031 State street; J. J. Dunbar & Co., [illegible] West 63rd street; Doyle & Co., [illegible] Dearborn street; B. J. Farwell, 42 Sherman street; Gilbert & Hungerford, 6327 Lake street, Oak Park, Ill.; Wm. Goyette, 1453 East 55th street; Hanley-Casey Co., 404 Ohio street; J. P. Heintz, 1127 Argyle street; T. G. Irving, 210 Lake street, Oak Park, Ill.; Samuel Kersten, 210 East Van Buren street; Lawrence & Stewart, 2906 Madison street; George Lillig & Co., [illegible] North [illegible] avenue; E. J. McDonough, [illegible] East Belmont avenue; Nelson & Wagner, 130 North Oak Park avenue; Nilson Brothers, 901 East Belmont avenue; Noble & Thumm, 2313 Lincoln avenue; O'Shea Bros., 3550 North Clark street; M. L. O'Malia, 908 Chicago avenue, Evanston, Ill.; Park Bros., 1564 Sherman avenue, Evanston, Ill.; H. P. Reger, 5514 Lake avenue; C. E. [illegible] Wentworth avenue; Wells & Smith, [illegible]8 South Halsted street, and Zimmerman Bros., [illegible] street and Avenue J, South Chicago.

Jamestown, N. D.—A new heating plant to cost $12,000 will be installed at Jamestown College, a donation of $6,000 having been duplicated by funds raised by the college. The new heating plant will occupy a separate building to be

built northeast of the president's home.

Sioux Falls, S. D.—The Custer City council has granted to the Custer Electric Light, Heat and Power Co. a 50-year franchise to operate an electric light system and power and heating plant in this city. Following are the company's officers: President, E. L. Grantham; vice-president, Joseph Kubler; secretary, H. E. Way; treasurer, T. W. Delicate.

Springfield, Ill.—A strike of operators on account of poor ventilation is reported from the Desnoyer shoe factory in Springfield. The management had painted and nailed down the windows. The men appealed to the city authorities without effect and then sent an appeal to the State factory inspector on the ground that the building constituted a fire trap.

Streator Heating & Light Co., Streator, Ill., is planning an extension of its heating mains in the residential section of Streator.

Hardy S. Ferguson, formerly chief engineer for the Great Northern Paper Co., has opened an office as consulting engineer at 200 Fifth avenue, New York. Mr. Ferguson will specialize in engineering work in connection with paper, pulp and fibre mills, including buildings and complete mechanical equipment.

University of Illinois Engineering Experiment Station will shortly publish a bulletin giving the results of recent fuel tests of house-heating boilers, conducted by Frank L. Busey, of the experiment station.

American Sheet and Tin Plate Co., Pittsburg, Pa., will equip its hot mill departments with air cooling systems.

Federal Furnace League has secured new headquarters at 1430 South Penn Square, Philadelphia. The office of president has been filled by the election of William J. Myers, who had been elected chairman of the executive committee. Charles S. Prizer was thereupon made chairman of the executive committee. Mr. Myers has just closed a term as president of the National Association of Stove Manufacturers.

Charles H. Simmons, president of the John Simmons Co., sailed for Europe May 20, with his family. He will be away two months.

Bangor, Me.—Among those who suffered losses in Bangor's [illegible] fire are the Fairbanks Co., dealers in heating and plumbing supplies; Noyes & Nutter, dealers in heating supplies; C. H. Rabb & Co., and Clement, Carter & Co., heating and plumbing contractors.

New Firms and Business Changes

Hern, Furlong Co., Boston, Mass., engineers and contractors for power, heating and ventilation, have opened an office at 149 Pearl street. The firm is composed of Joseph L. Hern, formerly superintendent of heating and ventilation with the School House Commission, Boston, and Francis J. Furlong, formerly superintendent of construction with the Cleghorn Co., Bradlee & Chatman and J. P. Dwyer.

Eastern Supply Association will hold its mid-summer meeting Thursday, June 22, 1911, at the Chalfonte, Atlantic City, N. J.

Houston, Texas.—An organization of a company to manufacture orchard heaters in Houston is now being planned by Dr. L. W. Fisher and F. H. Hammer of San Francisco, Cal. Such heaters have been tested in Colorado, California, and in other states in old fruit-growing districts. They are universally indorsed by the California Fruit Growers' Erchange. The advent of the heater in Texas next winter will serve to develop the citrus fruit industry on the gulf coast.

Bayley Heating Supply Co., Milwaukee, Wis., is the changed name of the Bayley Heating Co., of that place.

Hamilton, Ohio.—Plans will be drawn shortly by Architect George Barkman for a new steam heating plant for the county infirmary.

Manufacturers' Notes

Crane Valve Co., Bridgeport, Conn., is building a heavy machine shop 50 ft. x 355 ft., adjoining its plant in Bridgeport.

American Radiator Co. has sold its large warehouses at Harrison, N. J., and the company's stock will be transferred temporarily to the company's warehouses at 49 Communipaw avenue, Jersey City, N. J. It is now definitely known that the American Radiator Company has purchased 8½ acres in Bayonne with a frontage of 750 ft. on New York Bay, between Forty-eighth and Center streets, on which the company will build a new plant, including a two-story reinforced concrete warehouse with a floor area of nearly 144,000 sq. ft., also a foundry and machine shop.

Nashua Machine Co., Nashua, N. H., which, as announced in last month's issue, has purchased the Bundy trap business from the American Radiator Co., has opened a selling department at 127 Federal street, Boston, in charge of John Sabin, who was one of the first to introduce a tilting trap on the market.

McCrum-Howell Co., New York, announces the appointment of Howard T. Gates as general sales manager and Ernest E. Bell as eastern sales manager. The company's western sales manager is A. H. Schroth, who was appointed to that office January 1, 1911. George L. Greenman has resigned as the company's assistant sales manager to become eastern general manager of the Richmond Sales Company

Goulds Mfg. Co., Seneca Falls, N. Y., manufacturer of pumps, will build a $250,000 addition to its plant at that place.

Central Foundry Co., New York, manufacturer of soil pipe and fittings, which has been for some time in the hands of a receiver, has been reorganized with Receiver Waddill Catchings as president; De Courcey Cleveland, secretary and treasurer, and W. H. Feltt, assistant secretary and treasurer. The new company has sold $1,000,000 in bonds and will start business with the proceeds. The directors include J. N. Wallace, C. S. Smithers, August Heckscher, G. B. Malleck, N. B. Dill, P. J. Goodhart and G. H. Kinnicut.

H. Mueller Mfg. Co., Decatur, Ill., is improving its plant by the addition of a boiler house, a two-story brick building, 100 ft. square, which will furnish over 1000 H. P., or nearly double the former capacity of the plant. Additional machinery is also being added.

Shirley Radiator and Foundry Co., Shirley, Ind., announces the appointment of C. E. Gates as general manager of the

company. Additions are being built to the plant at Shirley, which will more than double its present capacity.

Garden City Fan Co., Chicago, announced the contemplated removal of its plant from Niles, Mich., owing to the failure of the Evans Heating and Plumbing Co. to include its apparatus in the mechanical equipment of the Niles High School building. Ten petitions have been circulated by residents of Niles petitioning the board of education to refuse to permit the installation of any other system.

Cutler-Hammer Mfg. Co., New York, announces the establishment of a new department to be devoted exclusively to the manufacture of industrial appliances for industrial heating. The department will be in charge of W. S. Hadaway, Jr.

Consolidated Engineering Co., Chicago, announces that in its suit against the Monash-Younker Co. for infringement of its Thermofier valve, Judge Sanborn, in the United States Circuit Court in Chicago, entered an order on March 16, 1911, in favor of the Consolidated Engineering Company for an injunction restraining the defendants from selling or installing the "Monash New Noiseless Radifier Valve." On appeal the Circuit Court allowed a supersedeas upon the condition that the Monash-Younker file within ten days a supersedeas bond in the penal sum of [illegible].

Buffalo Forge Company, Buffalo, N. Y., reports that its forge department is unusually busy with export orders for large installation of the Buffalo patented down draft forges in foreign railroad and industrial plants. Among these are the Havana Railways, Havana, Cuba, and the Central Railroad of Brazil.

Sprague Electric Company has been merged with The General Electric Company of Schenectady, N. Y. Its business will be connected under the name Sprague Electric Works of General Electric Company. The manufacture and sale of the lines of apparatus and supplies heretofore exploited by the Sprague Electric Company will be continued by the Sprague Electric Works of General Electric Company under the same organization, with D. C. Durland in charge as general manager. The offices of the Sprague Electric Works will be continued as heretofore, with main offices at 527-531 West 34th street, New York, and branch offices in principal cities.

New Incorporations

Frank Miller Plumbing and Heating Co., Toledo, O., capital [illegible].

Wetherell Heating and Plumbing Co., Carthage, Mo., capital [illegible]. Incorporators: C. N. Wetherell, D. N. Wetherell and [illegible] Wetherell.

Frush Plumbing Co., Waterloo, Ia., capital $25,000. President, George H. Frush; vice-president, William J. Cosgrove; secretary, Stephen Nullany; treasurer, [illegible].

Contracts Awarded

Frank Leary, Little Falls, N. Y., heating county farm buildings, for [illegible].

R. J. Mercer & Co., Traverse City, Mich., heating and plumbing new hotel at Boyne City, for $7,000. A vacuum heating system will be installed.

Hoffman & Conklin Co., Columbus, O., heating and ventilating new Bertha avenue and Hedges street schools in Mansfield, O.

Muller Heating Co., Milwaukee, Wis., heating and ventilating public school building at Sun Prairie, Wis., for $5,385.

America Heating Co., Rockford, Ill., heating South Park Lutheran Church in Rockford.

Buffalo Forge Co., Buffalo, N. Y., installing 9-ft. fan, pipe coil heaters and galvanized air ducts complete, in the dyehouse of the Farr Alpaca Company's Mill No. 2, at Holyoke, Mass. The system is similar to one installed a year ago at this plant by the same company and which has proven wholly satisfactory.

J. T. Cullen, of the Star Boiler Works, Clinton, Ia., contract to construct the new heating plant at the courthouse in Clinton, for $3,957. Two new boilers will be included in the installation, each 60 in. in diameter and 16 ft. long.

Probst Bros., Columbus, O., were lowest bidders, at $2,966.90, for the heating and plumbing of the Marion School in Columbus O.

Ahern-McCoy Co., Fond du Lac, Wis., heating, plumbing and gas fitting for the new $85,000 building of the Wisconsin Telephone Co., at Fond du Lac; also heating and plumbing the new Armory building.

J. C. Hurley, San Francisco, Cal., heating system and power house equipment for the new Odd Fellows' Home, near Los Gatos. The work will amount to $28,647. A vacuum cleaning system, costing $3,985, will be installed by the Vacuum Engineering Co.

American Warming and Ventilating Co., Pittsburg, Pa., heating and ventilating new $75,000 office building for the Republic Iron and Steel Co., at Pittsburg.

Trade Literature

Guaranteed Coal Saving, published by Frank L. Patterson & Co., 26 Cortlandt street, New York, is a new and timely catalogue designed to show how a considerable part of the fuel appropriation can be turned into profit by means of the Patterson-Berryman feed-water heater and purifier. The Patterson-Berryman apparatus is shown both in upright and horizontal styles for various requirements and the argument for Patterson-Berryman heater versus open heaters is presented at length. Views and descriptive matter are also given of the Patterson hot water service heater and of the Patterson exhaust pipe head. The catalogue closes with an impressive list of installations. Size 6x9 in. Pp. 48.

Buffalo Spray Nozzles and Strainers, made by the Buffalo Forge Co., Buffalo, N. Y., are presented in a new circular showing their adaptation for chemical plants, blast furnaces, mine moistening, gas washing, condenser systems, paper mills, cooling towers, agricultural purposes and for spraying insecticides. Size 4 x 8 in. Pp. 16.

Argon Valve, described as an automatic steam and hot water valve which will work under all conditions, is illustrated and described in circular matter published by the Argon Mfg. Co., Denver, Colo.

What Heat for Your House? a primer for the man who is about to build a new house or make an old house comfortable, is a useful compendium of information that cannot fail to give a clearer understanding of the subject to the layman as well as to many in the trade. The well-known advantages of steam and hot water for warming purposes are tersely pointed out and the adaptability of the Pierce boiler is treated in a separate chapter. The book is published by Pierce, Butler & Pierce Mfg. Co., Syracuse, N. Y., and no doubt a copy can be had for the asking. Size 4½x6½ in. Pp. 34.

Wyoming Automatic Eliminator and Wyoming Steam Trap, now marketed by the Potter Separator Co., Newburgh, N. Y., are the subject of a handsome catalogue well worth having. The Wyoming Automatic Eliminator is a device to get rid of the water in the steam line and its construction and operation are presented at length. It is made in vertical and horizontal types for steam pipes measuring from 3 to 16 in. in diameter. The Wyoming Steam Trap is shown to be a compact device which does not depend upon the buoyancy of the float to lift the discharge valve, the float being only instrumental in releasing a latch at its highest and lowest points of travel which, in turn, opens or closes the discharge valve. An interesting list of users is included in the catalogue, both the steam trap and Eliminator having been manufactured for some time by W. H. Nicholson & Co., of Wilkes-Barre, Pa. Catalogues of both devices may be obtained from the Potter Separator Co., either through its Newburgh office or at 30 Cortlandt street, New York. Size 6½x9½ in. Pp. 24.

Ideal Sylphon Heating Specialties, for controlling steam and water heating systems, tank water supply, etc., and made by the American Radiator Co., Chicago, are embraced in a newly-issued catalogue of more than ordinary attractiveness, giving, under one cover, detailed descriptions with illustrations, of Ideal Sylphon tank water regulators, Sylphon regitherms for steam or water boilers, hot air furnaces, gas supply regulation and

central heating; Sylphon steam regulators, Sylphon water regulators for hot water boilers or tank heaters, Sylphon tank regulators for holding the supply water at any desired temperature; also Sylphon vapor regulator for regulating dampers of vapor or atmospheric heating, Sylphon packless radiator valve, Sylphon automatic air valves, vacuum valves and vent valves; and Sylphon reducing valves for steady pressure reduction. The whole is included in a compact little volume which easily fits in the hip pocket or may be easily filed. Size 4 x 7 in. Pp. 40.

Marsh Quick-Opening Double-Heat Valves, made by the Marsh Valve Co., Dunkirk, N. Y., is a comparatively new valve and is shown in recently-issued circular matter in which the claim of superiority is made not only on account of the quick-opening and positive seal, but also that the metal lines are exceptionally heavy, and that the material, workmanship and finish are above those usually found. Two features of this valve are especially mentioned. One is that through the use of right and left-hand threads, working against each other, advancing a disc holder off the end of valve stem in closing valve, and by the use of high pitch threads in the valve bonnet, and low-pitch threads in the disc holder, the valve is operated with about one-third the number of turns required to open and close an ordinary valve. Through the use of low-pitch threads in advancing the disc holder off the end of the valve stem, the same grip or seating force is acquired as with low-pitch threads. The second feature is that in opening the valve, the disc in the top of the upper disc holder is seated in the valve bonnet in the same manner and with the same force in which the disc is seated in the bottom of the valve in closing same, thus providing against any possibility of leakage of steam or water around the valve stem or out through the stuffing box. The circular is well illustrated and contains price lists for sizes running from ½ in. to 3 in. for the Marsh standard globe valves and from ½ in. to 2 in. for the globe and angle radiator valves. Size 3¾x8¾ in. Pp. 18 (double folder).

District Heating Steam Plants, a paper by Paul Mueller, manager of the Erie Co., Erie, Pa., read before the American Society of Municipal Improvements, at Erie in October, 1910; also "The Development and Application of Central Station Heating," by Charles R. Bishop, read before the Pennsylvania Electric Association at Glen Summit Springs in September, 1910, have been reprinted by the American District Steam Co., No. Tonawanda, N. Y., and we understand that copies may be had for the asking. They are published as Bulletins Nos. 122 and 121, respectively.

Sparks System of Positive Steam Circulation, which is now owned and marketed by the Iroquois Engineering Co., Chicago, is the subject of an elaborate, new catalogue, which opens with a review of the principle of vacuum heating and then presents photographic reproductions of a number of representative buildings that have been equipped with the Sparks system. Interesting charts are presented showing record of vacuum in air line with pressure and when operating in connection with the Sparks system. The catalogue closes with detail

views of the Sparks devices, with full description of the mechanism and operation. Size 6x9 in. (standard). Pp. 48.

Paul Steam System Company's Return Line Valve is a new device which, it is stated, will discharge air and water at 50 lbs. pressure or 20 in. of vacuum, but absolutely no steam. It is announced that it will be sold without a royalty charge. The valve is being marketed by the Automatic Heating Co., acting as sales agents, West Street Building, New York, and Fisher Building, Chicago.

Dunham Vacuo-Vapor System of Heating, and the application of the Dunham radiator trap to vacuum steam heating, is the title of a handsomely gotten-up catalogue lately published by the C. A. Dunham Co., Marshalltown, Ia. The well-known Dunham devices are shown in new views and the Dunham vacuo-vapor system is illustrated and described in detail. Nine advantages of this system are stated to be: the system is a sealed one, it gives forced circulation of steam, perfect control of heat, a fool-proof system, a noiseless system, a system anyone can operate, a system in which either hot water or steam radiators may be used, no waste of water or steam, and last, it furnishes a hot water supply. Many buildings are shown in which the Dunham system is installed, the list including the Sherman Hotel in Chicago, where the recent Master Steam Fitters' convention was held. Size 6x9 , in. Pp. 68.

Cochrane Engineering Leaflet No. 6 is an interesting pamphlet describing a special boiler feed water heater for heating two water supplies separately and apart. The pamphlet is published by the Harrison Safety Boiler Works, 3189 North 17th street, Philadelphia, Pa. The heater is, in general, of the well-known Cochrane open type, receiving the exhaust steam through an attached oil separator. The water supplies, however, are received in two separate distributing boxes, which deliver to separate heating trays, from which the water drops into separate storage chambers, the idea being that in many plants there are two different water supplies which are used for two different purposes, as, for instance, where the condensed returns or condensate from surface condensers is to be used for washing or dyeing, while city or well water is used in the boilers. As compared with heating the two different water supplies separately in two different heaters, this arrangement represents a considerable saving on cost of heaters and of valves, piping, etc., while occupying much less room, and being more compact and convenient. The arrangement is designed to be used with the several modifications of the Cochrane heater.

THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK JULY, 1911

Mechanical Equipment of a Modern Factory Building

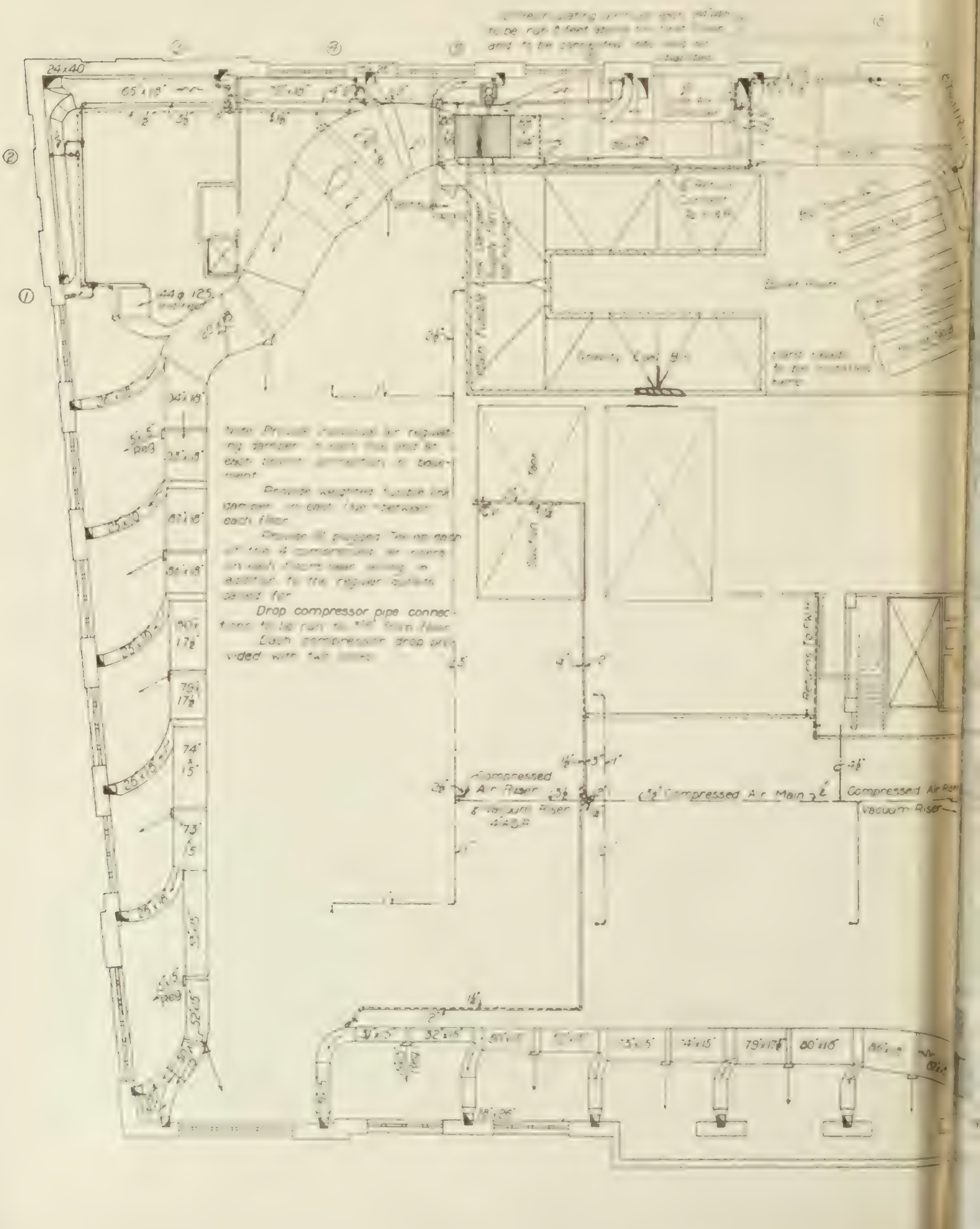
HEATING, VENTILATING, AND AIR WASHING SYSTEM IN PLANT OF BREWSTER & CO., LONG ISLAND CITY, NEW YORK

As a rule, we think of a factory as a building designed solely to fill the requirements of the industry, severely plain in its appearance and, perchance, displeasing to our æsthetic taste. But in the factory of Brewster & Company, Long Island City, N. Y., the architects, Stephenson &

FACTORY OF BREWSTER & CO., LONG ISLAND CITY, N. Y.

Wheeler, of New York, have shown that architectural beauty does not always have to be sacrificed in the design of a manufacturing plant.

This building, located on Bridge Plaza, between Prospect and Radde streets, is a six-story structure surmounted by an imposing tower. Its appearance is suggestive of a convention hall. That the comfort of the occupants has been given much consideration is shown by the fact

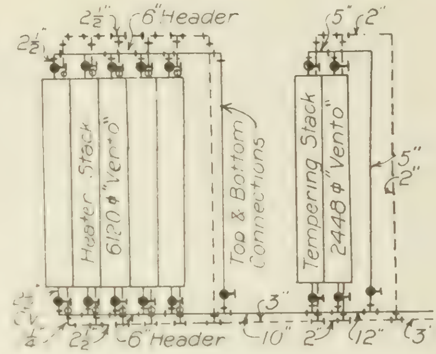


BASEMENT HEATING PLAN PLA

that the heating and ventilating system consists in every respect of the latest type of apparatus, including arrangements for cleansing and humidifying of the air which is performed by air washers made by Warren Webster & Co.

THREE SYSTEMS OF HEATING AND VENTILATING

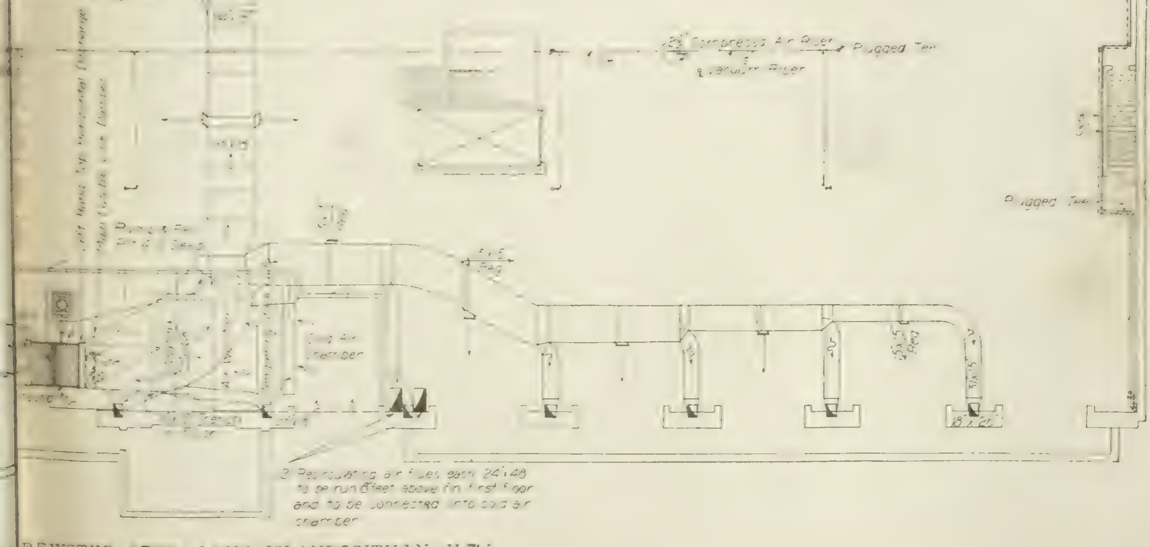
The heating and ventilating plant consists of three systems. Practically the entire building is heated by the fan system. However, in certain rooms on the second and sixth floors, supplemental direct radiation from a one-pipe system is used. A two-pipe system of domestic steam supply is provided for certain "Domestic steam radiation, including steam boxes, glue heaters, steam kettles, etc. Radiators connected with the one-pipe system furnish the heat for the tower and the tank house on the roof, while the main office vestibule on Prospect street is taken care of by an indirect heater suspended from



DIAGRAMMATIC SKETCH OF MAIN PIPING TO TYPICAL HEATER AND TEMPERING STACKS.

the basement ceiling immediately below, encased in galvanized iron connected to main supply air ducts.

The fan system consists of two sets of apparatus, located in opposite sides of the basement, and each supplying to half of the building properly cleaned and humidified fresh, warm air. Each group consists of a tempering coil, air washer, reheater, and fan driven by a direct-

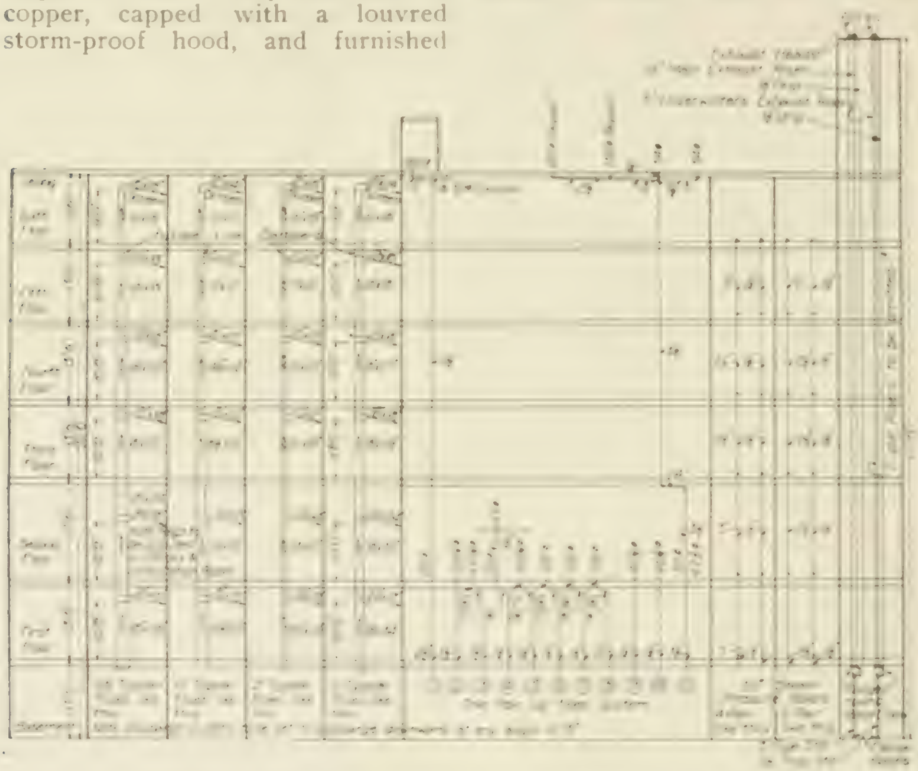


REWSTER & CO., LONG ISLAND CITY, N. Y.

connected vertical steam engine. Inasmuch as the only difference in these sets is that one fan is a right-hand top horizontal and left-hand bottom discharge, while the other is the reverse, the same description applies to both.

On both Prospect and Radde street sides of the building are located the fresh air intakes for the respective fans. They are made of copper, capped with a louvred storm-proof hood, and furnished with fine mesh copper screens and dampers. After leaving the cold air chamber the air passes over the tempering stacks, consisting of 2,448 sq. ft. of American Radiator Company's Vento radiating surface and enters the air washer. From this point it is drawn through the reheater of 6,120 sq. ft. of Vento radiating surface and distributed by the fan to the two main ducts, from whence it is delivered to the various floors.

The capacity of each of the air washers is 85,000 cu. ft. per minute. They are built of galvanized steel, braced with 2 x 2 x 3/16-in. angles. The spray device extends the full width of the spray chamber and is made up of a brass water pipe, with 7/32-in. perforations on both sides, over which runs a curved copper hood. The water jets from the spray pipe impinge on the inside surface of the hood in such a manner that a double sheet of water is formed through which all the air must pass before being delivered to the building. The spray water falls into a tank below and is re-circulated by means of a Tacony Iron Co.'s brass-fitted turbine pump direct-connected to a Crocker-Wheeler motor. On leaving the air washer the air is drawn over the reheater and then is forced to the various floors.



COMBINED HEATING AND VENTILATING RISER DIAGRAM. PLANT OF BREWSTER & CO.

The fans have 68-in. inlets, the discharge being horizontal at the top and annular at the bottom. The 12-in. x 10-in. vertical enclosed self-oiling steam engine is capable of driving them at 250 R.P.M.

In connection with the tempering and reheating stacks, there is installed a Powers system of temperature control. This is accomplished by a cold air thermostat operative at 38° to 40° F. in such a manner as to guard the air-washers at all times against freezing.

When the temperature of the entering air drops below 38° F. the tempering coils are supplied with steam, the thermostat being connected to the supply and return valve of the individual groups of the tempering coils. In connection with this system there is an automatic electric air compressor with suitable storage tank, automatic governor, indicating gauge, etc.

The tempering stack consists of two groups of 60-in. Vento cast-iron radiators, each group being 36 sections wide and 3 sections high. The reheating stack is similar to this, with the exception that it is 5 groups deep instead of two.

Steam is supplied to the systems by three Heine (150 H.P. each) water-tube, longitudinal drnm type boilers located in the basement, and the working pressure carried is 150 lbs. In this connection it might be stated that these boilers were installed under extreme limited headroom conditions, 12 ft. 5 in. only being available in the clear. It was, therefore, necessary to resort to making the nozzle connections out of the front drums. For the domestic steam system a reducing valve allows the use of 30 lbs. steam. The exhaust from the fan engine is used in the heating system, supplemented by live steam where necessary. The water of condensation from all the hot blast heating stacks is removed by an automatic pump.

The flues of the fan system discharge in general about 10 ft. above the floor of the room and downward at an angle of about 15°. Screens of the plain lattice or diamond design mesh are provided. Above the register faces are placed adjustable regulating dampers.

PROVISION FOR RECIRCULATING AIR

A recirculating flue connection is made to each intake chamber so that, during the closed down period of the factory, the building is heated by recirculated air. Another advantage of this arrangement permits of the rapid heating of the building during the early morning hours by a rapid circulation of the recirculated air.

The entire steam power plant, heating, ventilating and forge supply exhaust plants, were designed and supervised by Messrs. Griggs & Holbrook, of New York, consulting engineers for the Brewster Company, and were installed by the Fentzlaff Heating and Plumbing Company, also of New York.

A Plan to Advance Foreign Trade

American manufacturers and producers are invited to file with each American consulate a statement respecting the lines of goods they have to offer to foreign buyers.

Heretofore American manufacturers have had the privilege of filing catalogues in the consulates, but the diversity of size and form of catalogues and other printed matter thus far filed, and the filing of this printed matter in English in consulates requiring other languages, has entailed unnecessary time and expense in clerical force, correspondence and translation work in the consulates. It is now proposed to obviate these disadvantages by asking each manufacturer to prepare a brief of his catalogue or printed matter according to card index specifications, these cards to be classified in card index files under proper headings, and to print same in the various commercial languages.

This coöperative plan has been arranged between the Department of State and the Commercial Bureau Company for placing with each American consulate an encyclopedia of the industries of the United States. The work, we understand, is done without charge to the manufacturer. Full particulars will be given by The Commercial Bureau Company, 50 Church St., New York.

A Movement to Standardize Catalogues

A committee of the American Society of Mechanical Engineers has been appointed to take up the subject of the standardization of catalogues. The members of the committee are Prof. William Kent, W. B. Snow, M. L. Cooke and J. B. Bibbins.

Coefficients of Heat Transmission*

By John R. Allen,

PROFESSOR MECHANICAL ENGINEERING, UNIVERSITY OF MICHIGAN.

Transmission of heat from surfaces, both conducting and non-conducting, is of great interest to every engineer connected with heating work. There have been many experiments made along these lines, but there is still a vast field that is untouched and many simple facts we do not know.

We may divide these surfaces into two general classes; those in which the heat passes from the surface by the natural circulation of the air along the surface produced by the heated surface itself, and those in which the air passes by the surface due to a forced circulation, as in a fan system. In the first class a large portion of the heat is given off by radiation and in the second it is almost all given off by convection. Consider first those surfaces along which the air circulates by natural draft.

Engineers have generally agreed in this case that the transmission of heat depends upon the difference in temperature between the air in the room and the steam in the radiator multiplied by a certain constant depending upon the form and the condition of surface. At the University of Michigan, we have for about twenty years been conducting experiments upon the transmission of heat through surfaces and we find that, under similar conditions, the coefficient of transmission for the same radiators remains constant. The constants are determined in the following manner: The condensation of the steam in the radiator is carefully determined per square foot of surface, and this multiplied by the latent heat of the steam at the given pressure gives the heat loss per square foot of surface. Dividing this loss by the difference in the temperature between the steam in the radiator and the temperature of the air in the room gives the coefficient of heat transmission. The foregoing table gives the coefficient of heat transmission for various radiators.

TABLE I

HEAT TRANSMISSION FROM DIRECT RADIATORS

Type of Radiator Cast Iron	No. of Square Feet	[illegible]	Coefficient of Transmission
1 column	[illegible]	.212	1.82
2 column	[illegible]	265	1.65
3 column	[illegible]	204	1.45
4 column	[illegible]	[illegible]	[illegible]
WROUGHT IRON			
1 column	[illegible]	446	3.27
2 column	[illegible]	286	2
3 column	[illegible]	294	1.77
4 column	[illegible]	202	1.27
1-IN. PIPE COIL			
1 pipe high		[illegible]	[illegible]
4 pipes high		.425	[illegible] 48
WALL COIL	Sq. Ft. per Sec.		
Section vertical....	[illegible]	[illegible]	[illegible]
Section horizontal................	[illegible]	[illegible]	2.11
Section vertical..................	7	[illegible]	1.70
Section horizontal................	[illegible]	[illegible]	1.92
Section vertical..................	9	[illegible]	1.77
Section horizontal................	[illegible]	[illegible]	1.98

Height of cast-iron and wrought-iron radiator is 38 in.

In order to determine how nearly constant this coefficient remains, a series of experiments were made at varying room and steam temperatures. The following table gives the results of this experiments. You will notice that for ordinary conditions of opera-

*Read at the third annual convention of the National District Heating Association, June 6-8, 1912.

tion this coefficient remains fairly constant, so that it is hardly necessary to take the variation into consideration, except in very accurate work, and then only where the range of temperature is very great does the variation in this coefficient materially affect the heat loss from the radiator.

TABLE II

HEAT TRANSMISSION THROUGH CAST-IRON RADIATOR UNDER VARYING CONDITIONS OF TEMPERATURE

Difference in Temperature	Coefficient of Transmission
80	1.56
100	1.58
120	1.615
140	1.645
150	1.65
160	1.675
170	1.69
180	1.705
190	1.72

The transmission of heat through radiators and also the coefficient of transmission will be affected by the temperature of the surfaces to which the radiator radiates its heat. In the first experiments that were made at the University of Michigan, the room used had very little outside wall or window surface.

Some fifteen years later this apparatus was moved into another room containing a large amount of window surface. The effect of this change was very marked. The coefficient of transmission was raised about 7%. This accounts for the fact, which is well known, that in greenhouse heating the rules are entirely different from those used for an ordinary house. Where radiators are exposed so that the direct rays of heat from the radiator strike directly on cold glass surfaces at a low temperature the radiation loss is measurably increased. This is of great assistance to the engineer for, if he figures his radiation too low in a room with large glass surfaces, he is helped by the fact that the radiator gives off more heat and tends to make up for the lack of surface.

The coefficients given in the previous tables are given for rooms having an average amount of glass surface.

The transmission of heat through radiators is also affected, to a small degree, by humidity. The effect of humidity is shown in the following table:

TABLE III

EFFECT OF HUMIDITY ON THE TRANSMISSION OF HEAT THROUGH CAST-IRON RADIATOR

Percentage of Moisture Saturation	Coefficient of Transmission
20	1.79
30	1.77
40	1.73
50	1.72
60	1.69
70	1.66
80	1.63
90	1.61
100	1.59

You will notice that as the humidity in the air increases the heat losses from the radiator diminish. This is contrary to what might be expected, but the reason for it is quite evident when carefully considered. Water vapor occupies twice the volume of air under the same pressure so that when the air in the room is moistened we have less weight of the medium passing the radiator than when the air is dry, and therefore less heat lost by convection, which lowers the total heat transmission. The effect of the moisture in the air through the most extreme ranges of humidity only changes the coefficient of transmission about 5%.

TESTS OF INDIRECT RADIATORS

In indirect radiators, where the air passes over the surface at a high velocity, and this velocity is subject to a wide range depending upon the conditions of operation, it is necessary, in determining the coefficient of transmission, to take into consideration the velocity of the air passing over the surface, as well as the difference in temperature between the temperature of the air outside and the steam inside the radiator. The results deter-

mined from experiments go to show that this coefficient is almost constant and may be determined in the following manner:

Divide the B. T. U. transmitted per hour by the difference between the average temperature of the air passing the radiator and the steam in the radiator. Divide this quotient by the number of cubic feet of air passing per square foot surface per hour. The final quotient will be the coefficient. The following table gives this coefficient for an indirect pin radiator of standard form and for a long pin indirect radiator. The irregular variations in the coefficient are undoubtedly due to the errors in observation. You will notice that the coefficient increases as the velocity of the air passing the radiator is increased.

Similar coefficients of transmission may be obtained for fan coil radiation. This is determined in exactly the same way as above with the exception that the final divisor is the velocity of air passing the radiator in lineal feet per minute. The following table gives the coefficient of heat transmission for 1-in. pipe fan coils. It will be noticed from this table that the coefficient varies with the depth of the fan coil surface. For any given number of sections the coefficient remains approximately constant.

The object of obtaining these coefficients is to enable the engineer to compute approximately the heat losses in the given forms of surfaces under all conditions. We have these heat losses pretty well determined by experiment for ordinary conditions of operation, but the engineer frequently meets with conditions of operation which are exceptional, and by means of this coefficient he will be able to determine the heat losses, at least approximately, under these exceptional conditions.

The laws governing the heat transmission through various surfaces are really not well determined. Much experimental work must be done along these lines in order to enable the engineer to make his computations more exactly. The most successful rules for de-

TABLE IV

COEFFICIENT OF TRANSMISSION FOR INDIRECT PIN RADIATION

Cu. Ft. of Air per Hr. per Sq. Ft. Surface	B.T.U. per Hr. per Sq. Ft. Actual Surface per Deg. Diff. between Air and Steam		Coefficient	
	Short Pin	Long Pin	Short Pin	Long Pin
50	.8	1.0	[illegible]	2.0
[illegible]	1.52	1.55	1.52	1.55
[illegible]	2.25	2.20	1.49	[illegible]
200	2.85	2.75	1.43	1.45
250	3.55	3.25	1.42	1.30
[illegible]	4.25	3.7	[illegible]	1.23
350	4.85	4.2	1.385	1.20

TABLE V

COEFFICIENT OF TRANSMISSION FOR FANHEATER COILS (OUSTIDE TEMP. 0° F.)

No. of Sections	Velocity Through Heater in Feet Per Minute									
	800		1000		1200		1400		1600	
	Vento	Pipe Coil	Vento	Pipe Coil	Vento	Pipe Coil	Vento	Pipe Coil	Vento	Pipe Coil
1	.120		.120	....	.120		[illegible]		.120	
[illegible]	.0595	.0535	.0592	.0575	.059	.058	.0585	.058	.058	.0575
[illegible]	.0398	.0350	.0399	.0379	.040	.040	.041	.041	.042	.040
4	.0301	.0240	[illegible]	.0269	.030	.030	.038	.030	.039	.030
[illegible]	.240	.0160	.0240	.0203	.0240	.028	.0240	.030	.0239	.029
[illegible]	[illegible]	.0140	.0199	.0165	.0199	.019	.0199	.019	.0198	.019
[illegible]	.0172	.011	.0171	.0145	.0170	.017	.0171	.017	.0171	.0165
[illegible]	.0149	.099	.0151	.0125	.0150	.0155	[illegible]	.016	.0150	.0155

termining heat losses in transmission through building are those developed by the German engineers and given in a small pamphlet published by J. H. Kinealy, who has translated the German work into English. This is entitled "Formulas and Tables for Heating." These German engineers have given coefficients for conditions sometimes met with by engineers which are not familiar to a great many Americans. The following coefficients might be added to the list of those already given.

	Coefficient.
From air to smoke through a clay plate ⅜ in. thick to air	1
From air to smoke through cast-iron or sheet-iron plate to air	1.4—2
From air to smoke through cast-iron or wrought-iron plate to air on outside	2.6—4
From steam through cast-iron or wrought-iron plate to air	2.2—2.6
From steam through metal wall to water	160—200

The coefficients given in the above table assume that the medium on the two sides of the plate through which the air is heated is circulated by natural circulation. These conditions are very much modified if the medium on the two sides of the plate is given a more rapid circulation. The following table shows the variation coefficient of heat transmission due to the velocity of the water passing along the walls of condenser tubes:

TABLE VI

HEAT TRANSMISSION FROM STEAM TO WATER IN CONDENSER TUBES (FROM DATA)

Velocity of Water, Feet per Minute	Coefficient of Transmission
40	220
60	350
80	450
100	520
120	600
140	680
160	750
180	800
200	850
220	900
240	940

All experiments thus far show that in general the coefficient increases with the increased velocity of the medium on the two sides of the plate. The laws governing the effect of such velocities are not known. At the present time the University of Michigan is carrying on an elaborate series of experiments with fan heaters, and with the heating by hot water, with the hope that some more definite information may be obtained with reference to the effect of the velocity upon the heat transmission through metal surfaces. One reason why more work has not been done along these lines is the fact that such experiments require elaborate and expensive apparatus and years of time.

Vapor Heating Systems

By Thomas G. Mouat

Some interesting observations on the principle and operation of vapor heating systems are contained in a discussion of the subject by Thomas G. Mouat before the Ohio Society of Mechanical, Electrical and Steam Engineers. Among other things Mr. Mouat said:

About twenty-six years ago, while working as an apprentice at the steam-heating trade, I heard a journeyman steam-fitter remark that vapor was the coming heat. I asked him what he meant by the term "vapor," and he said it was steam slightly above atmospheric pressure. In those days and for many years following it was deemed necessary to carry from 1 to 10 lbs. of steam pressure to heat a building successfully with the ordinary gravity low-pressure system without the

means of producing a partial vacuum; and most boiler manufacturers still set the pop valves to blow at 15 lbs.

But this steam fitter's prophecy has been realized, and though it is a far cry from 10 lbs. pressure to 2 oz. pressure, it has been practically demonstrated that a building can be heated in the coldest weather with from 2 to 3 oz. pressure, and the term "vapor heat" is now applied to a steam-heating system which operates under this very low pressure.

The main object of vapor heating is to provide for a system that will operate with just a little heat turned on each radiator, enough heat to be comfortable without over-heating in moderate weather and plenty of heat for the coldest days, by simply opening the supply valves a little further. Each room may be heated regardless of the rest of the building, to suit the requirements of the occupant or the purpose for which it is used.

Several attempts were made from time to time to perfect a system, which would permit the partial heating of the radiators, but in each case they met with failure due to the inability to control the pressure with the ordinary diaphragm damper regulator and devices of this character, where the steam pressure was directly applied to do the work.

I remember years ago reading of an English heating engineer who invented a system which could be graduated to some extent. He advocated locating the boiler in a pit about 4 ft. deeper than the ordinary basement floor, so that the water could not back up in returns high enough to cause any trouble when the pressure got too high. This system was not practical. A boiler put so deep is dangerous to the occupants of the house, and difficult to take care of; it may be too low for the ordinary sewer connections, so that the pit could not be drained; and the pressure variation provided for and sure to occur was too great to guarantee any practical result along the lines of graduation.

It was not until the direct application of steam in connection with a diaphragm was dropped, and the energy of water plus the steam pressure was employed for the purpose of regulating the boiler pressure, that a system permitting positive and practical graduation was perfected.

The graduated admission of steam to each radiator may now be accomplished in a properly constructed vapor system by the use of a sensitive pressure and damper regulator attached to the boiler, fractional valves and special return fittings on the radiators, and an opening in the return pipe near the boiler to permit the escape of air. No air vents are used on the radiators.

The regulator must be so constructed that it will open or close with the variation of 1 oz. of pressure. This result has been obtained by a regulator operated according to the principles of a hydraulic balance, water being forced out of a stationary tank into a movable tank placed at the end of a lever which causes the movable tank to tilt downward and close the dampers. When the pressure has dropped an ounce, part of the water leaves the movable tank and returns to the stationary tank; the movable tank is then tilted upwards by the aid of a counter-weight and the reverse operation of lever and dampers occur. This regulator is positive in operation; when the pressure decreases there is nothing to hold it shut, and with an increase of pressure it must close, as the power exerted by the pressure plus the weight of water is greatly in excess of the force required to operate the regulator.

There is also a regulator on the market operated by a float in a tank placed alongside of the boiler. When the water is forced out of the boiler the float is raised and the drafts closed. When the water in the tank drops back into the boiler again the

float descends and the dampers are opened.

The graduating valves are constructed so as to permit a small amount of steam to enter the radiator, so little that it will be condensed in heating a small portion of it, or they may be opened still farther and so heat the entire radiator. The valves are furnished with stop screws so that they may be set to heat the entire radiator without permitting any steam to pass through the radiator into the return pipe.

The valves are generally placed at the top connection of the radiator. Water radiators are used, which heat horizontally along the top first and thence downward according to the amount of steam turned on. The return fitting is placed at the opposite end and connected to the bottom connection of the radiator. This return fitting is constructed with a small water seal which presents a full opening for the flow of condensation into the return pipe, and a restricted opening for the escape of air into the same pipe. This restricted opening and water seal retard the flow of steam into the return pipe. The air and water travel together to a point near the boiler, where an opening for the escape of the air is provided in the top of the return pipe. From this a pipe leads to the chimney flue, where a slight reduction in pressure is caused tending to help the removal of the air. The water separated from the air falls to the boiler.

A low pressure is absolutely necessary in order to permit circulation under graduation, and a practically constant pressure is required to perfect the graduation.

The ordinary steam-heating system with its variable pressure, uncertain regulation, and tendency toward vacuum will not permit of any graduation. A sufficient reduction of pressure in the radiator due to the partial closing of the supply valve would immediately fill the radiator with water through the return pipe; or in a one-pipe system the radiator would gradually fill with water if the supply-valve area was materially curtailed.

No vacuum can be produced in a vapor-heating system of this type because, as has been already stated, it is open to the atmosphere. With the ordinary steam-heating system the supply valves must be either turned on full or shut off tight, which frequently makes the rooms either too hot or too cold, causing waste of fuel and discomfort.

With the vapor-heating system the pressure is generally much higher in the supply pipes than in the radiators. It may be 2 oz. in the pipes and only a small fraction of an ounce in the radiators, due to graduation and condensation. The water of condensation returns to the boiler at a very low temperature, averaging about 85° F., and with some vapor systems the return water may be reheated by means of the waste gases, and, owing to its own low temperature, it is capable of absorbing a large amount of heat which would be otherwise wasted in the ordinary steam system on account of the much higher temperature of the return water.

There are a good many other reasons which recommend the vapor system to the public and I will mention a few of them: the very low pressure at which the system operates reduces the cost of maintenance to the minimum. It is noiseless in operation, as there is not enough pressure to produce noise. It is economical in operation, due to the sensitive regulation, the very low pressure and the graduation. It is capable of keeping up steady heat from 10 to 12 hrs. with hard coal without attention, always insuring a warm house in the morning. There are no air vents to leak, sputter, or emit odors into the rooms. It is much quicker to act than hot-water heat. The danger from leakage or freezing is reduced to the minimum.

The radiators are smaller than used for hot water, and about 15% larger than for the ordinary steam systems.

When natural gas is used for fuel, the regulator is attached to a butterfly valve on the gas supply pipe, which prevents over-pressure and makes the system almost automatic, with the ex-

ception of turning the valves on and off at the radiators.

The safety valves are set to blow at 8-oz. pressure. I have been heating my own home during the last two months with about ¾-oz. pressure at the boiler.

Altogether the vapor-heating system is a very satisfactory means of modern heating, and I recommend it to your further investigation.

In reply to questions Mr. Mouat stated that a hot-water system could be changed to a vapor system by providing a steam space in the boiler. The low steam pressure of ¾ oz. was measured by a water-column, and not by an ordinary spring steam gauge. He considered the vapor system safer than a water system on account of the water-seal and automatic water supply.

*The Official Federal Furnace League Method of Testing Furnaces**

By Dr. W. F. Colbert,

Engineer of the Federal Furnace League

At the last annual meeting of the Federal Furnace League it was decided that a standard method of estimating furnace heating requirements and a standard method of installing furnaces should be adopted.

It was also decided that furnaces should be rated in accordance with the standard system of installation adopted and that the ratings of furnaces should be based on actual tests performed by disinterested persons. Accordingly, the executive committee of the league was instructed to have prepared for the league a standard system for installing furnaces and to take such steps as they might deem necessary to carry on the testing and rating of furnaces in accordance with the standard system adopted.

THE LEAGUE'S TESTING STATION

A building was erected and equipped, and in the latter part of January, 1911, I received notice that the engineering department of the league was to take charge of the testing station on February 1, and I was instructed to carry on the work of testing furnaces as rapidly as circumstances would permit.

EQUIPMENT OF TESTING STATION

The testing station, located at Newton Square, Pa., is a two-story frame building about 60 ft. long by 16 ft. wide. The first story is used as a furnace room and is provided with four permanent furnace foundations and underground cold-air ducts (the inlet to each cold-air duct being controlled by a hinged door); with four permanent smoke-flues (with an electric pyrometer for reading the temperature of gases leaving the furnaces), and with eight heat-pipe connections to the second story of the building. On the second floor are the eight heat-pipe outlets, two for each furnace, with a recording anemometer and a standard thermometer for each pipe.

This equipment makes four complete testing stations of graded sizes, as follows:

Station No. 1.—(For furnaces up to 20 in. average fire-pot diameter), has a foundation for furnaces with 32 in. to 44 in. casing diameters, cold-air duct 10 in. x 22 in., smoke-flue (36 ft. above grate), 7 in. diameter, two 14-in. diameter heat pipes connected to two riser pipes, each with a net cross-section area of 1.03 sq. ft.

Station No. 2.—(For furnaces with 20 in. to 24 in. average fire-pot diameter), has a foundation for furnaces with 40 in. to 52 in. casing diameters; cold-air duct 12 in. by 26 in.; smoke-flue (36 ft. above grate), 8 in. diameter; two 17-in. diameter heat pipes connected to two riser pipes, one with

*Presented at the annual meeting of the Federal Furnace League at New York May 9, 1911.

a net cross-section area of 1.435 sq. ft. and the other with a net cross-section area of 1.42 sq. ft.

Station No. 3.—(For furnaces with 24 in. to 29 in. average fire-pot diameter), has a foundation for furnaces with 50 in. to 62 in. casing diameters; cold-air duct 14 in. by 34 in.; smoke-flue (36 ft. above grate), 9 in. diameter; two 20-in. diameter heat pipes connected to two riser pipes, one with a net cross-section area of 2.08 sq. ft. and the other with a net cross-section area of 2.10 sq. ft.

Station No. 4.—(For furnaces with 29 in. to 36 in. average fire-pot diameter), has a foundation for furnaces with 60 in. to 72 in. casing diameters; cold-air duct 18 in. by 44 in.; smoke-flue (36 ft. above grate), 12 in. diameter; two 20 in. by 25 in. square collars tapered to 25 in. diameter heat-pipes connected to two riser pipes, each with a net cross-section area of 3.35 sq. ft.

HOW THE READINGS WERE TAKEN

After the riser pipes and the permanent sheet metal work were all in place, the pipes were standardized by placing at the center of the pipe the anemometer that in future was to be used in the pipe, and by placing other anemometers at various points in the pipes. Readings for a period of 10 min. were taken and the positions of the anemometers were changed (except the center anemometer) and another reading taken. This was repeated from three to five times on each pipe until practically the entire area of the pipe had been compared to the center. This procedure was followed out not once, but several times on each pipe, the work taking more than two weeks to complete, and when the results of these repetitions were compared, the variation was found to be less than .005. From the complete series of results on each pipe an average was struck and is now in use.

These standard ratios are as follows:

Station No. 1, pipe No. 1, aver. reading, Center × 1.043
pipe No. 2, aver. reading, Center × 1.108
Station No. 2, pipe No. 1, aver. reading, Center × 1.08
pipe No. 2, aver. reading, Center × 1.376
Station No. 3, pipe No. 1, aver. reading, Center × 1.172
pipe No. 2, aver. reading, Center × 1.225
Station No. 4, pipe No. 1, aver. reading, Center × 1.272
pipe No. 2, aver. reading, Center × 1.141

The fact that the average in every case is greater than the center reading is due to the curved baffles at the base of the riser pipes, causing an increased velocity of flow of air at the back of the pipe. The variations in ratio are due to variations in the curve of the baffle plates.

In addition to these corrections for velocities in pipes, it is necessary to make an allowance for variations in heat losses in pipes. The proportion of uncovered pipe surface on the other stations is not as great as on Station No. 1, accordingly we had to find a standard ratio to equalize the heat loss on the other stations.

A rough estimate was made and compared with results obtained by interchanging furnaces from one station to another. By this method we obtained corrections for heat losses in pipes as follows:

Station No. 1—Multiply total test results by 1.000
Station No. 2—Multiply total test results by .988
Station No. 3—Multiply total test results by .963
Station No. 4—Multiply total test results by .988

The heat loss in pipes as corrected represents a little more than 20% of the heat delivery at the outlets—*i. e.*, the furnaces deliver at the crown a little more than 120% of the amount of heat recorded at the outlets. For the purpose of rating, we use the delivery at outlets, assuming that the heat lost in uncovered pipes at the testing station does not exceed the heat loss in covered pipes in an actual installation (the Federal system requires all heat pipes to be covered with a good non-conducting covering).

In addition to these fixed corrections, there are corrections for fuel consumed in each test and corrections for average temperature of air passing through the furnace.

LOW-GRADE ANTHRACITE COAL USED

The coal used for testing is a low-grade anthracite, stove size, with a large percentage of cinder and ash, and a low heat value. This low-grade fuel was ordered so that we might be certain that the fuel used in the tests was not better than that used in furnaces in actual operation.

The correction for coal consumption will necessarily vary with different

samples of coal, and although it can be worked out theoretically, the theoretical correction does not include the latent heat in the ashes and cinders of the residuum, which varies with the condition of the fire and temperature of the residuum. The correction for fuel now in use at the testing station is as follows:

Pounds of residuum minus 14% of the total weight of wood and coal used equals pounds of carbon which, when multiplied by 16,000, equals B. T. U. of heat in residuum and this total when divided by 12,000 equals the value in pounds of coal, which, when subtracted from the weight of coal put into the furnace, gives the actual amount of coal consumed. This amount is divided into the amount of coal the furnace should burn in eight hours, and the resulting fraction is used as a factor to correct the test results to the standard.

The correction for average temperature of air passing through the furnace is obtained as follows: Under the Federal system the maximum register temperature is 150° F., corresponding to a temperature of over 180° F. at collars on bonnet of furnace. It is assumed that the average temperature of air passing over the heating surfaces in the furnace would be 100° F., or two-thirds of 150° F. (the register temperature). From the average temperature of air at outlets, we subtract the average outdoor temperature and add two-thirds of the remainder to the average outdoor temperature. From this sum we subtract 100, and the remainder represents the number of parts per 1,000 the increased temperature has diminished the air heating power of the furnace. This factor is used to correct the results obtained in the tests to the results that would have been obtained under zero weather conditions.

THE METHOD OF TESTING

The method of testing is rather complicated and a description without illustration would be very confusing. Probably the best way to describe the method of testing would be to conduct an imaginary test on a No. 548 "Hot Stuff" furnace, manufactured by the "Hot Stuff" Heater Co.

The furnace is described in the catalogue as a 25-in. diameter fire-pot with a 48-in. diameter casing. The manufacturers have shipped the furnace to us with two 20-in. diameter outlets in the bonnet.

Before the furnace was set up in the testing station we measured the fire-pot and found the dimensions to be as follows:

Diameter at top of fire-pot	25 in.
Diameter at bottom of fire-pot	22 in.
Average diameter of fire-pot.......	23.5 in.
Depth of fire-pot	1[illegible] in.

(Depth of fire-pot in tests is limited to 15 in.)

On this basis the cubic contents of the fire-pot are:

23.5″ × 23.5″ × 0.7854 × 15″ = 506 cu. in.
6506 ÷ 1728 = 3.765 cu. ft. × 64 = 241 lbs. coal.

The furnace had an average fire-pot diameter less than 24 in. and was set up on Station No. 2 and connected to the 17-in. diameter round heat pipes by 20 in.-17 in. tapering joints of the pipe. The smoke outlet of the furnace (8 in. diameter) was the same size as the smoke flue of Station No. 2. Paper and 24 lbs. of wood (10% of the coal capacity of the fire-pot) were placed in the fire-pot, and at 8.40 A. M. the fire was lighted. At 9 A. M. the fire was examined and the wood was found to have burned to red-hot coals, accordingly 96 lbs. of coal (40% of the coal capacity of the fire-pot) were put in the fire-pot and all drafts turned on and the anemometers in the heat pipes started. At 9.30 A. M. the temperature of the air at each outlet pipe was taken and recorded separately, and the outdoor temperature was taken and recorded. After the temperatures were recorded, 145 lbs. of coal (60% of the coal capacity of the fire-pot) were placed in the fire-pot.

At 10 A. M. the temperature of air at each outlet pipe was taken and the outdoor temperature was taken again and these temperatures were recorded in spaces on the test card alongside of those taken at 9.30 A. M. These temperatures were taken every 30 min. until the end of the test at 5 P. M.

At 10 A. M. the smoke-flue temperature was recorded, and was recorded every hour thereafter until 5 P. M.

At 10.30 A. M. the ash-pit door of the furnace was closed and the draft door set open at the first notch. The condition of the fire was noted every hour, and at 2 P. M. it became apparent that the coal was being consumed a trifle too rapidly. The draft door was closed, and at 4 P. M. the draft door was again opened one notch. At 5 P. M. all temperatures were recorded, the anemometers were stopped and the fire was dumped. The ashes, cinders and burning coals were scraped out of the ash-pit and weighed. The weight of this residuum was 60 lbs. The record at the end of the test was substantially as follows:

SPECIMEN FEDERAL FURNACE LEAGUE TEST CARD NO. Z

Manufacturer, Hot Stuff Heater Co.

No. 548. Name, Hot Stuff. Station No. 2.

Pipe Correction— x 0.988.

Fire-pot capacity, 3.765 cu. ft. Coal capacity, 241 lbs.

Wood used, 24 lbs. First charge of coal, 96 lbs. Second charge of coal, 145 lbs.

Should burn in 8 hrs. 193 lbs. coal. Actually burned in 8 hrs. 210.5 lbs. coal.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Average
Pipe No. 1 Temp. Deg. F..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	256	257	256	[illegible]	[illegible]	229	227	228	209	181	160	220
Pipe No. 2 Temp., Deg. F..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	261	263	263	258	257	230	229	233	215	188	164	224
Outdoor Temp., Deg. F....	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	59	60	60	61	62	62	61	60	60	59	59	59
Chimney Temp., Deg. F....	...	340	...	660	...	640		620		600	...	480		440		380	520

Pipe No. 1—Anemometer C—Finish.............. 2,227,742
Area—1.435 sq. ft.—Start........................ 2,025,788

Correction—x 1.08 480) 201,954(420
2 correction

422 ft. per min.

Pipe No. 2—Anemometer D—Finish.............. 2,275,906
Area—1.42 sq. ft.—Start........................ 2,087,371

Correction—x 1.376 480) 188,535(393
3 correction

396 ft. per min.

422 × 480 × 1.435 × 1.08 = 313,927 cu. ft. 396 × 480 × 1.42 × 1.376 = 371,401 cu. ft.

313,927 × .0585 × 161 × .238 = 703,700 B.T.U. 371,401 × .0581 × 165 × .238 = 847,384 B.T.U.

1,551,084 B.T.U. × [(.988 × 193/210.5) ÷ 9,324] = 1,409,158 B.T.U.

1,409,158 B.T.U. ÷ 8 = 176,145 B.T.U. per hr. delivered at registers.

176,145 B.T.U. + 20% = 211,374 B.T.U. per hr. at bonnet of furnace.

Date of test, May 9, 1911. Engineer in charge, Wm. F. Colbert.

5% to 35% increases in percentage efficiencies.

The rate of combustion in the tests is a trifle high when the fire-pot depth is 15 in. or over, but it must be borne in mind that only the larger-size furnaces have such deep fire-pots. In fire-pots less than 15 in. deep the rate of combustion is diminished in proportion. It is also to be remembered that the furnaces are rated on the basis of the Federal system of heating, in which the allowances for heat losses are very high to cover poor building construction. In a good building the furnace will carry its rated load on a much lower rate of fuel consumption than was required of it in the tests.

Finally, it should be borne in mind that the average rate of combustion during an entire heating season is only about one-half the combustion rate in zero weather, which means that throughout the heating season a furnace will show a decided increase in heating efficiency over that obtained in the tests conducted in the basis of zero weather heating requirements.

TESTS DETERMINED MAXIMUM CAPACITY

The tests as conducted are maximum-capacity tests, not efficiency tests. On the furnaces tested, by varying the rate of combustion to produce a proper ratio between the pounds of coal burned per hour and the square feet of heating surfaces in the furnace we could produce from

The accuracy of the method of testing and of the results obtained can only be demonstrated by control tests. The official tests on several furnaces

have been repeated from time to time for the purpose of checking results and demonstrating the accuracy of the method. To date the variation in final results have not exceeded .0063; notwithstanding the fact that the tests have been made at an interval of ten days or more, with variations of nearly 20° in outdoor temperatures, with variations in wind velocities and with variations in rate of combustion amounting to 3%.

I believe that these control tests have demonstrated that our test results are as accurate as can reasonably be expected and that our method of testing furnaces produces results more accurate than those heretofore described in the literature on the subject.

A New Basis for Rating House-Heating Boilers*

DEVELOPMENT OF A FORMULA WITH THE TERM HORSEPOWER AS THE UNIT OF HEATING EFFECT

By Frank L. Busey

For small medium-sized heating installations, steam and hot-water boilers and warm-air furnaces are used for the same class of work, depending on the requirements and available funds. Each has its own advantages and its own advocates, so there should be some common or comparable basis of rating, or of making a comparison of the results to be expected from the various units. This rating should be expressed in some small quantity, in order that it be easily handled and comprehended. It should be, if possible, in some well-known and established term, such as American Society of Mechanical Engineers standard horsepower, universally used in referring to large power and heating boilers. Heating installations will usually range between 2 and 50 H.P., where the installation is intended strictly for heating purposes.

The question of a fair and proper rating for house-heating apparatus has often been discussed, without definite results, and the need of a solution to the problem is sorely felt by all who come in contact with the boiler and furnace business. Some manufacturers are equipped to test their boilers properly, and so arrive at a fairly accurate determination of what performance their product is capable. On the other hand, a considerable number of builders have no adequate means of conducting tests and would be unable to interpret the results in case such tests were made. These are the parties who are guilty of placing apparatus on the market which has a catalogue rating of two to three times what can be developed under normal working conditions. As a result, the business is in an unsatisfactory state as regards ratings, and the crying need of the trade is for some uniform system whereby the heating capacities of the various types of boilers and furnaces may be closely approximated from the design and dimensions of the unit under consideration.

An appreciation of this need has led the writer to turn his attention to the rating question, with the result that a number of interesting conclusions have been derived. These results will be presented herewith, together with the methods by which they were obtained. A study was made of several hundred tests made by the University of Illinois Engineering Experiment Station on various types and sizes of small boilers and furnaces, and also of tests made on other and larger units, the results of which could be relied upon.

*[illegible]

The practice of using 10 or 12 sq. ft. of heating surface in a boiler as equivalent to 1 H.P. is hardly warranted in house-heating boiler work, since the rate of combustion, ratio of heating surface to grate area and consequent variation in efficiency may invalidate such a system. As a matter of fact, the amount of surface required may vary anywhere from 5 to 50 sq. ft. per horsepower, depending on the conditions mentioned.

HORSEPOWER AS THE UNIT OF HEATING EFFECT

Various combinations were tried and discarded, and it was finally decided to use the term horsepower as the unit of heating effect, as applicable to both steam boilers and warm-air heaters. Taking the A. S. M. E. standard of 34.5 lbs. of water evaporated per hour from and at 212° F. as equivalent to 1 B.H.P., we have 34.5x970.4 = 33,479 B.T.U. as also equal to 1 H.P. In the case of the boilers, the equivalent evaporation from and at 212° F. per hour divided by 34.5 gives the horsepower developed. With the warm-air furnaces the pounds of air heated per hour multiplied by the rise in temperature and the specific heat of air, gives the number of B.T.U. delivered per hour to the air. This in turn divided by 33,479 gives the horsepower developed by the furnaces.

GRATE AREA AND RATE OF COMBUSTION

Having determined the total horsepower developed by the various units tested, the next step was to find some dimension, relation, or ratio to which the horsepower developed could be referred, and so obtain a unit to which the horsepower would bear some definite relation. It was found that the horsepower developed upon each square foot of grate by 1 lb. of dry fuel burned per hour on each square foot of grate surface was remarkably constant. This is true for any one boiler or furnace when burning dry coal per square foot of grate per hour between the limits of 4 to 8 lbs. for small units and 5 to 10 lbs. for the larger units, and when using coals of a similar quality. This is shown very clearly in Figs. 1 and 2 for two separate units, each using two classes of fuel. This value, termed a horsepower constant, and designated by the letter K, was obtained for each test analyzed, by dividing the horsepower developed by the grate area, and this quantity in turn by the rate of combustion. Since

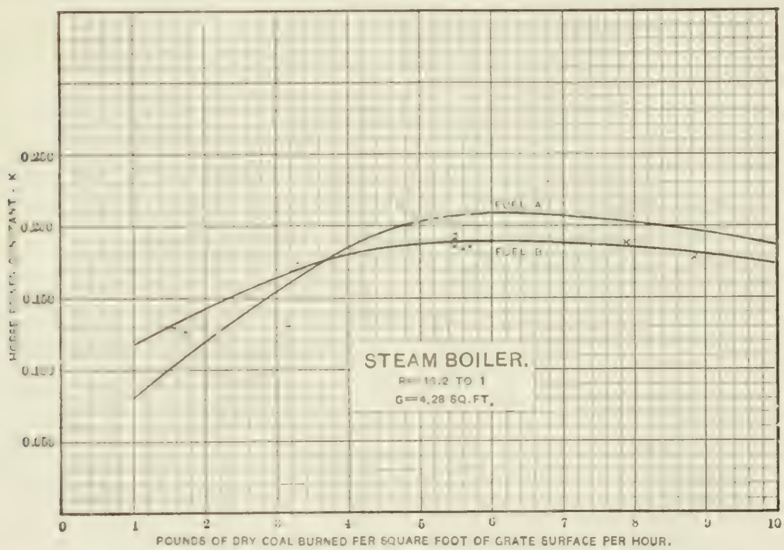


FIG. 1. RELATION OF HORSE POWER CONSTANT TO RATE OF COMBUSTION

frequent reference will be made to the grate area and the rate of combustion for any one heating unit, these terms will be designated by the letters G and F, respectively.

DEFINITE RELATION BETWEEN K AND R

While K was constant for any one unit and for similar quality of coal, yet different units gave different values of K. It was found that the higher values of K were obtained from units having a greater number of square feet of heating surface for each square foot of grate, this number being the ratio of the total square feet of heating surface to the square feet of grate. This ratio will be designated by the letter R. For a similar quality of coal, the values of K from the different units were then plotted to the corresponding values of R, as shown in Fig. 3. It is seen that there exists a very definite relation between the values of K and R.

This relation appears reasonable, for, other conditions being equal, higher efficiencies will be obtained with higher values of R. Thus in practice it is customary to use additional sections, resulting in higher values of R, and also greater capacity. The relation between K and R was found to be independent of the size of the unit tested, inasmuch as increase in size actually accompanied by the increasing value of R. This accounts for the higher efficiencies obtained from large units.

It is well to know that the use of various grades of coal results in different efficiencies in the same unit. From a study of the tests made it was found that the coals used could be divided into three general classes, designated as classes A, B and C. Class A includes anthracite, coke and semi-bituminous coals. Class B includes good grades of bituminous coal, such as is mined in Williamson, Franklin and Saline counties of the southern District of Illinois. Class C includes the poorer grades of bituminous coals. We have already seen that when using any one class of a coal a definite relation exists between K and R. Although different values of K are obtained when using the different classes of coal, yet each class has its own definite relation between K and R. This is well illustrated in Fig. 3, where the three curves refer to the different classes of fuel.

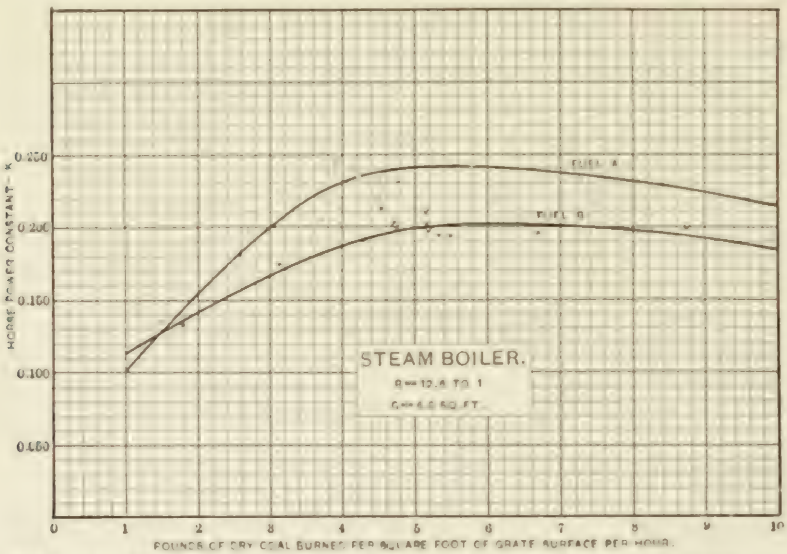


FIG. 2. RELATION OF HORSE POWER CONSTANT TO RATE OF COMBUSTION

COAL ANALYSIS

Table 4 shows the average proxi-

TABLE 4

AVERAGE PROXIMATE ANALYSIS OF FUELS USED, FUEL AS FIRED

	Fixed Carbon Per Cent.	Volatile Per Cent.	Moisture Per Cent.	Ash Per Cent.	Sulphur Per Cent.	B.T.U. Per Lb.
Class A—Anthracite	78.25	7.13	3.49	11.15	1.30	12820
Coke	80.50	3.26	6.30	9.94	0.90	12015
Semi-Bituminous	74.57	18.79	1.49	5.15	0.74	14780
Class B—Bituminous	49.07	34.91	6.84	9.19	1.82	12250
Class C—Bituminous	41.59	38.05	10.79	9.57	2.97	11340

mate analyses of the three classes of coals as they were used during these tests. The term "good" or "poor," as here used, refers to the performance of the coal when used in small house heating units and not for large power boilers. The comparatively low furnace temperatures attained in the smaller furnaces make it impossible to burn completely the excessive amounts of volatile matter contained in these coals designated as "poor bituminous." For this reason they soot up the flues and cut down the efficiency.

DIFFERENCE IN EFFICIENCY OF BOILER

It is customary in order to get the same heating effect to build warm-air furnaces with a much greater value of R than is used with steam and hot water boilers. This is on account of the fact that more heat can be transmitted through one square foot of heating surface to water than to air. Tests show that in warm-air furnaces R must be from two to three times as large as in boilers to give the same efficiency, and correspond very closely with practice.

As a result of these facts, K does not bear the same relation to R in furnaces as in boilers, due to the greater value of R necessary in furnaces to obtain the same value of K. It follows that the relation of K to R varies, not only with the different class of fuels used, but

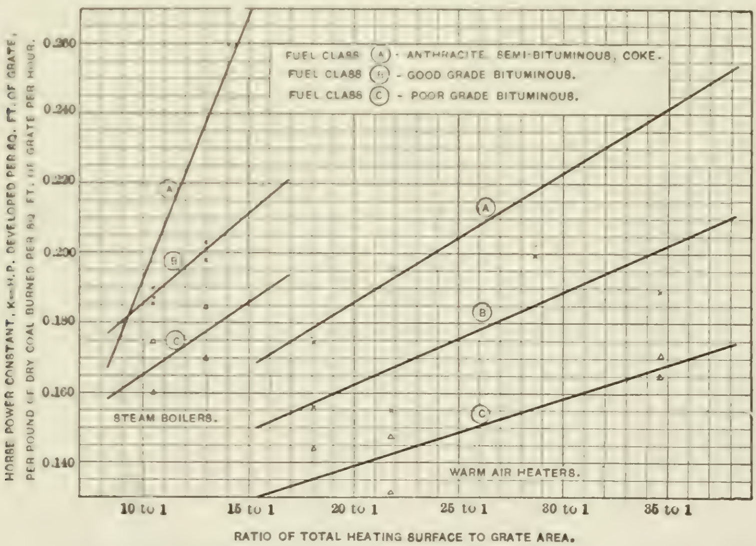


FIG. 3. RELATION OF HORSE POWER CONSTANT TO RATIO OF HEATING SURFACE TO GRATE AREA

with the different type of heating unit, being clearly shown in Fig. 3.

Fig. 3 shows the relation between the horsepower constant K and the ratio of total heating surface to grate area R. The general relation of the curves A, B and C for furnaces and curves B and C for boilers is seen to be very similar, the better fuels giving the higher efficiencies. This difference increases slightly as the value of R increases. An increase in the value of R is accomplished by an increase in the value of K only in so far as the value of R is confined to the limits found in practice.

These limiting values of R for boilers in which this relation was found to hold are between 8 and 15. This range for furnaces, however, is from 15 to 38. It is quite probable that the higher value of 15 set for R in the case of boilers can be increased to 20 or even above, but it was impossible to obtain sufficient data to prove absolutely this point. Nevertheless the indications are that this is the case. There would eventually come a point where the temperature of the flue gases would be reduced to so nearly the temperature of the surrounding water or air that no further gain would be effected by increasing the radiating surface.

Curve A, in the case of the boilers, shows a much greater difference in favor of the high carbon over the bituminous coals as the radiating surface increased. This difference is probably due to the comparatively restricted flue passages as ordinarily used in steam and hot water boilers, in which the soot from the bituminous soals tends to deposit and so cut down the efficiency. In warm-air heaters the radiator is usually made of such ample proportions that less difficulty is experienced with soot deposits. If the ratio of heating surface to grate could be increased, and at the same time the gas passages kept of ample size, curves B and C would no doubt tend to assume an inclination more nearly like that of curve A.

It is evident that an increase in the radiating surface of boilers is productive of greater gain in efficiency when using Class A fuels rather than the ordinary bituminous coals. With boilers having a low value of R good grade of bituminous coal may be expected to give as good results as are to be obtained with anthracite or eastern semi-bituminous coals.

Having found that the values in Fig. 3 can be represented by straight lines within the limits of the tests used, the next step was to derive a formula and determine the proper constants applicable to the various sets of conditions.

Let G = Area of grate surface in sq. ft.
F = Pounds of dry fuel burned per sq. ft. of grate surface per hour.
R = Ratio of total heating surface to grate area.
K = Horsepower constant = h.p. developed per sq. ft. of grate per lb. of dry fuel burned per sq. ft. of grate per hour.
H.P. = Total horsepower developed.
C_1 and C_2 = Constants for any one set of conditions.

It will be noticed that the average deviation of the points from the lines as drawn is less than 3%, and that the maximum deviation is 7.5%. This shows how closely actual performance, as shown by a study of several hundred tests, may be approximated by the use of the formulæ and constants given in Table 1.

Then these lines are represented by a formula of a form

$$K = C_1 R + C_2$$

In this formula C_1 and C_2 have definite values for any one set of conditions—that is, for one type of heating unit in various sizes, when using one class of coal.

The various sets of values for C_1 and C_2 have been carefully determined and are tabulated in Table 1. Thus the formula for warm-air heaters for a fuel in class A becomes

$$K = 0.0037R + 0.112$$

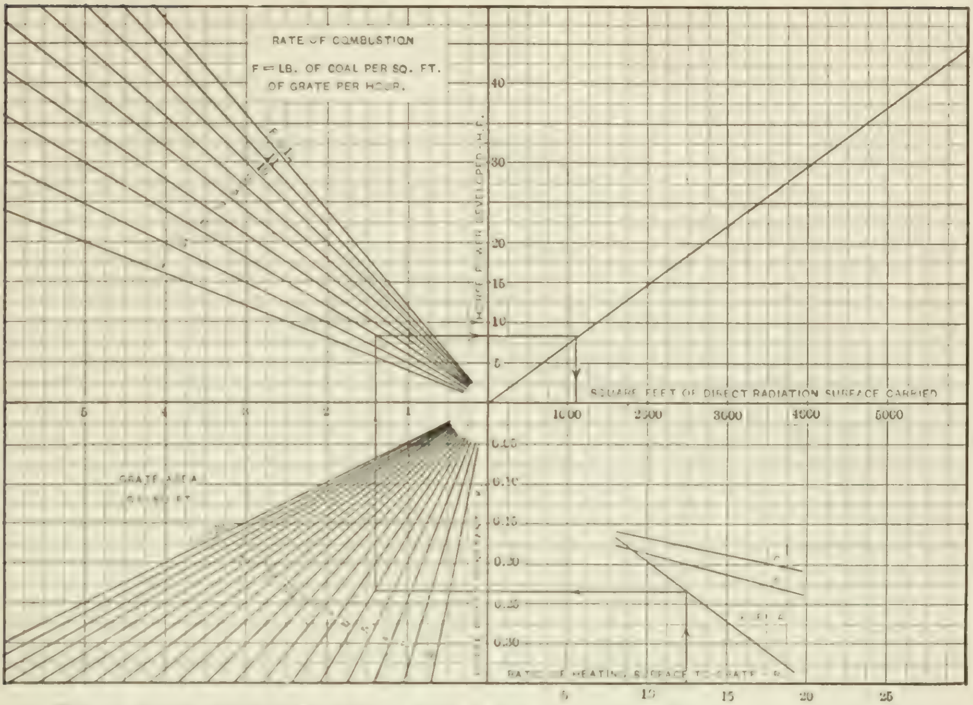


FIG. 4. DIAGRAM OF HORSE POWER DEVELOPED AND LOAD CARRIED BY VARIOUS SIZES OF BOILERS

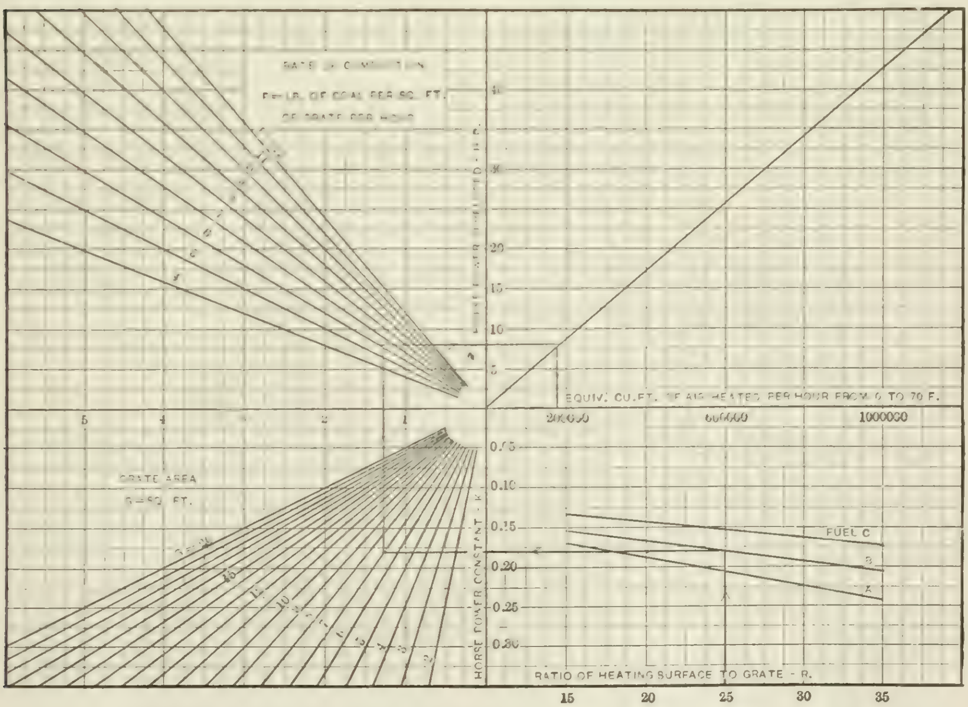


FIG. 5. DIAGRAM OF HORSE POWER DEVELOPED AND LOAD CARRIED BY VARIOUS SIZES OF FURNACES

TABLE 1

VALUES OF C_1 AND C_2 FOR THE FORMULA $K = C_1R + C_2$

	Fuel	C_1	C_2
Steam Boilers	Class A—Anthracite, Semi-Bituminous, Coke..	0.0150	0.046
	" B—Good Grade Bituminous	0.0052	0.135
	" C—Poor Grade Bituminous...	0.0041	0.126
Warm-Air Heaters	Class A—Anthracite, Semi-Bituminous, Coke..	0.0037	0.112
	" B—Good Grade Bituminous	0.002	0.110
	" C—Poor Grade Bituminous	0.0020	0.101

For any unit under consideration this formula gives us the value of K, or the horsepower that is developed on each square foot of grate surface by each pound of fuel burned per square foot of grate per hour. Knowing K, the grate area, and the most desirable rate of combustion, the total horsepower developed can be readily determined by the formula

$$H.P. = K \times G \times F$$

The A. S. M. E. standard of 34.5 lbs. of water evaporated as one horsepower was used, hence 1 H.P. = 33,479 B.T.U. This in turn divided by 250 gives the number of square feet of direct radiating surface carried—taking the standard of 250 B.T.U. emitted per square foot per hour. With warm-air furnaces the B.T.U. delivered to the air per hour divided by 1.4356 (the heat required to raise 1 cu. ft. of air from zero to 70° F.

As previously explained, the value of K, of the B.T.U., or of the heating effect, as given in Tables 2 and 3, when multiplied by G and F give the total horsepower developed, total B.T.U delivered, or total heating effect, under the conditions assumed. Fig. 4 for boilers and Fig. 5 for furnaces have been drawn to show more clearly the effect of the various combinations of the factors already discussed. From these figures can be readily traced the entire course from heat unit to the horsepower developed for any set of conditions.

HOW TO USE CHARTS

Referring to Fig. 4 let us assume a boiler with a value of R= 12.5, a grate area of 6 sq. ft. and a rate of combustion of F=6 lbs. Then, if we are to use anthracite, we will follow the vertical line upward from the point where R=12.5 until we intersect the line A. From this intersection we follow the horizontal line to the left through the point K =0.235 until we intersect the line G =6. From this point we trace the vertical line upward until we reach the line F=6. Following the horizontal line to the right from this point it is seen that under these conditions the horsepower developed is 8.5. On tracing it farther to the right until we intersect the diagonal line, then dropping downward on the vertical line we find the equivalent heating surface served to be 1,150 sq. ft.

In the same manner for warm-air furnaces on Fig. 5, the values can be traced as shown. From R=25, fuel B, G=7, F=6, to 7.8 H.P. or a heating effect of 180,000 cu. ft. of air warmed per hour from zero to 70° F. This operation can be reversed, with either Fig. 4 or 5, thus working from the amount of heat needed back to the unit to be selected.

CONCLUSIONS

(a) Any basis of rating selected for heating installations should be equally applicable to steam and hot water boilers and to warm-air furnaces, as they are used for similar requirements.

(b) A unit of rating should be of such a character that it may be easily expressed and comprehended, of some standard form that may be compared to that used for power boiler rating.

TABLE 2.—VALUES OF HORSE-POWER CONSTANT *K* FOR VARIOUS VALUES OF RATIO *R*, STEAM BOILERS

R Ratio of Total Heating Surface to Grate Area	Fuel A			Fuel B			Fuel C		
	K Horse Power Constant	B.t.u. per Hour Delivered to the Water	Square Feet of Radiation Served	*K* Horse Power Constant	B.t.u. per Hour Delivered to the Water	Square Feet of Radiation Served	*K* Horse Power Constant	B.t.u. per Hour Delivered to the Water	Square Feet of Radiation Served
8 to 1	0 166	5560	22 2	0 177	5925	23 7	0 159	5320	21.3
9 "	0 181	6060	24 2	0 182	6090	24 4	0.163	5455	21.8
10 "	0 196	6560	26 2	0 187	6260	25 0	0.167	5590	22.4
11 "	0 211	7065	28 3	0 192	6430	25 7	0 171	5730	22.9
12 "	0 226	7565	30 3	0 197	6595	26 4	0.175	5865	23.5
13 "	0 241	8065	32 3	0 203	6785	27 1	0 179	6000	24.0
14 "	0 256	8570	34 3	0 208	6960	27 8	0 183	6135	24.5
15 "	0 271	9070	36 3	0 213	7130	28 5	0 188	6280	25.1
16 "	0 286	9575	38 3	0 218	7300	29 2	0 192	6420	25.7
17 "	0 301	10075	40 3	0 223	7465	29 9	0 196	6550	26.2
18 "	0 316	10575	42 3	0 229	7665	30 7	0 200	6690	26.8
19 "	0 331	11080	44 3	0 234	7835	31 3	0 204	6830	27.3
20 "	0 346	11580	46 3	0.239	8000	32 0	0 208	6965	27.9

(c) The term horsepower as used in the A. S. M. E. rating for power boilers is a measure of heat delivered, is applicable to both boilers and furnaces, and fulfills better than any other term the above requirements.

(d) The heat generated, or the power developed, on each square foot of grate by the combustion of 1 lb. of fuel on that square foot of grate, has been found to be practically a constant, under the conditions as already outlined. This is true of both boilers and furnaces.

(e) This constant bears a definite relation to the size of the heating unit, as expressed by the ratio of its total heating surface to grate area. Based on the results of actual tests, this relation can be expressed by a simple formula and the above constant determined for different units and sets of conditions.

TABLE 3.—VALUES OF HORSE-POWER CONSTANT *K* FOR VARIOUS VALUES OF RATIO *R*, WARM AIR HEATERS

R Ratio of Total Heating Surface to Grate Area	Fuel A			Fuel B			Fuel C		
	K Horse Power Constant	B.t.u. per Hour Delivered to the Air	Equivalent Cu. Ft. of Air Heated per Hour from 0° to 70°F	*K* Horse Power Constant	B.t.u. per Hour Delivered to the Air	Equivalent Cu. Ft. of Air Heated per Hour from 0° to 70°F	*K* Horse Power Constant	B.t.u. per Hour Delivered to the Air	Equivalent Cu. Ft. of Air Heated per Hr. from 0° to 70°F
15 to 1	0.168	5610	3906	0 151	5040	3511	0.131	4385	3054
16 "	0.171	5730	3993	0.153	5130	3573	0 133	4455	3103
17 "	0.175	5855	4078	0 156	5220	3636	0.135	4520	3148
18 "	0.179	5980	4165	0 159	5310	3699	0.137	4585	3194
19 "	0 182	6105	4251	0.161	5400	3761	0.139	4655	3243
20 "	0.186	6225	4338	0.164	5490	3824	0.141	4720	3288
21 "	0.190	6350	4424	0.167	5580	3887	0.143	4785	3333
22 "	0.193	6475	4510	0.169	5670	3950	0.145	4855	3382
23 "	0 197	6600	4597	0.172	5760	4012	0.147	4920	3427
24 "	0.201	6725	4683	0 175	5850	4075	0.149	4990	3476
25 "	0.205	6845	4769	0.178	5940	4138	0.151	5055	3521
26 "	0.208	6970	4855	0.180	6035	4204	0.153	5120	3566
27 "	0.212	7095	4942	0.183	6125	4266	0.155	5190	3615
28 "	0.216	7220	5028	0 186	6215	4329	0.157	5255	3660
29 "	0.219	7340	5114	0 188	6305	4392	0.159	5325	3709
30 "	0 223	7465	5201	0.191	6395	4455	0.161	5390	3754
31 "	0.227	7590	5287	0.194	6485	4517	0.163	5455	3800
32 "	0.230	7715	5373	0.196	6575	4580	0.165	5525	3849
33 "	0.234	7835	5459	0.199	6665	4643	0.167	5590	3894
34 "	0.238	7960	5545	0.202	6755	4705	0.169	5660	3943
35 "	0 242	8085	5632	0.205	6845	4768	0.171	5725	3988
36 "	0 246	8210	5718	0 208	6935	4831	0 173	5795	4034

(f) The difference between the horsepower developed by actual test and that calculated by the use of this formula is comparatively slight. The calculated horsepower may be used in connection with the ordinary heating job, with entire satisfaction.

(g) The use of the diagrams Figs. 4 and 5 will expedite the work of calculation, and for any ordinary case is sufficiently accurate. Where greater accuracy is desired the formula and the values of C_1 and C_2 from Table 1 may be used.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Semi-Annual Meeting, Chicago, July 6-8, 1911

After providing a three-day hot spell of record-breaking intensity, the Chicago weather man, scenting the approaching heating engineers from afar, discreetly changed his tactics and served a brand of weather for their mid-summer meeting that approached the ideal. Prepared to withstand the city's heat as best might be, arrangements had been made to hold the professional sessions on the nineteenth floor of the La Salle Hotel. Here with two sides exposed to the lake, it was hoped that some relief would be offered by the lake breezes. As it turned out, the opening session was called to order with a miniature gale sweeping through the assembly room, actually compelling the closing of the French windows on both exposed sides.

Under these delightful weather conditions, which continued throughout the meeting, a programme of unusual variety and interest was successfully carried out. The registered attendance was 107.

MORNING SESSION, JULY 6

The first session was opened with the president, Reginald Pelham Bolton, in the chair. George Mehring, of the Illinois Chapter, welcomed the society to Chicago, paying a glowing tribute to the influence of the visiting members in dispelling the city's heat wave.

Mr. Mehring was followed by J. F. Wing, of the Chicago Association of Commerce, who extended a welcome on behalf of his association.

President R. P. Bolton then presented his address which was a decided departure from the customary type of address, being in the form of a study of the effects upon the climatic conditions of New York City by the vast quantity of heat emanating from its industries and from the heating of its buildings.

Mr. Bolton showed that the occurrences of zero temperature and below in New York City are becoming rare and, at the same time, the precipitation during the winter months is also falling off. He cited the fact that the amount of coal consumed in 1900 for the generation of power for transit purposes was 1,343,573 tons. During the same period the electrical lighting companies consumed 884,757. These two items, together with the amounts of coal used for the production of gas, in breweries, in private power plants, in domestic plants and in river tugs and vessels, together with the amount of oil consumed, 137,000 gals. per year, brings the total annual consumption of coal or its equivalent to a total of 18,950,000 net tons, or enough to add 3½° F. to the temperature of the atmosphere, one-half mile in height, over an area of 130 square miles, covering the principal portions of the city.

The effect of this addition to the heat of the atmosphere on decreasing the precipitation was explained by Mr. Bolton on the ground that this increase in the temperature would add about 3½% to the moisture absorbing capacity of the atmosphere. Mr. Bolton attributed the foggy condition in and about London to this cause.

In reporting the work of the Illinois Chapter, Samuel R. Lewis, referred to the critical illness of James Mackay, one of its most prominent members, and at his suggestion a resolution was passed extending the greetings and good will of the society to Mr. Mackay.

Prof. James D. Hoffman, general chairman of the Compulsory Legislation Committee, told of the new ventilation laws passed in Indiana, Kansas and North Dakota, which have been published in these columns. He also told of the progress of similar bills in New York (for factories), Massachusetts, Nebraska and Wisconsin.

Prof. Hoffman expressed an opinion that was warmly endorsed by other speakers that the committee should draw up a so-called ideal ventilation law, to be known as the "standard" ventilation law. With such a basis to work on, the various state committees could then proceed to incorporate as many of these features in their proposed legislation as was found practicable.

Mr. Theodore Weinshank told how the Indiana ventilation law was modified, before passage, by the elimination of one word, "only." The original bill read, "no schoolhouse to be heated by direct radiation only." By leaving out this word, said Mr. Weinshank, the use of direct or direct-indirect heating system is prohibited in schoolhouses in Indiana.

Mr. A. S. Armagnac called attention to the fact that in Ohio a building code, recently enacted, contained a reference to the ventilating of theatres and similar places of assembly, the code providing that such buildings shall be supplied with at least 1,200 cu. ft. of fresh air per occupant per hour.

Reporting for the Committee on Heating Guarantees, Mr. W. M. Mackay read a number of letters favoring the proposition that the designing engineer should guarantee his designs and that the contractor can only be rightly held for the proper installation and for the materials, that is, for the complete performance of his contract. This view, said Mr. Mackay, was one which he also shared.

This disposed of the committee reports and the first paper on the programme was then presented, entitled "Free Engineering," by Perry West and George W. Knight. This paper was read by Prof. J. D. Hoffman.

In discussing this paper Mr. J. H. Davis called attention to the fact that vacuum heating systems were for a long time not acceptable to heating engineers until the manufacturers guaranteed their plants. The same condition existed with respect to blower manufacturers.

Topical discussion then followed on the "operation and care of heating and ventilating apparatus" and on the "reluctance to divulge alleged secrets in relation to engineering practice."

Mr. Normal L. Patterson stated that in Chicago operating engineers were under the local civil service and that their efficiency in handling their apparatus was one of the principal points considered in their promotion. Cook County, he said, has instituted a similar system of civil service.

AFTERNOON SESSION, JUNE 6

The afternoon session was opened with the reading of a paper by Paul P. Bird on "Some Phases of Smoke Prevention." This was followed by a much-discussed paper by Frank L. Busey, of the University of Illinois Experiment Station, on "New Basis for Rating House Heating Boilers and Furnaces." (Mr. Busey's paper is published on another page of this issue.) A third paper read at this session was presented by A. W.

Glessner, entitled, "Tests on Double Wall Warm Air Furnace Piping."

The remainder of the session was taken up with topical discussion.

MORNING SESSION, JULY 7

Friday morning's programme included a paper by Samuel R. Lewis on "Heating and Ventilating High School Buildings in Decatur, Ill.," and a paper by D. M. Quay, on "Ventilation of the Macy Store, New York." A paper by W. Thorn was also read on "Street Car Ventilation." Numerous given topics were also discussed, the meeting coming to final adjournment at noon.

The following were present and registered:

MEMBERS AND GUESTS

Reginald Pelham Bolton, New York.
John R. Allen, Ann Arbor, Mich.
W. W. Macon, Brooklyn, N. Y.
Jas. H. Davis, Chicago.
A. S. Armagnac, New York.
W. M. Mackay, New York.
W. H. Johnson, Indianapolis.
J. D. Hoffman, Lafayette, Ind.
Emmons Collins, Chicago.
B. F. Raber, Lafayette, Ind.
Thomas Tait, Moline, Ill.
Dr. E. von Rehm, Chicago.
L. C. Soule, Chicago.
Frank L. Busey, Chicago.
John D. Small, Chicago.
N. L. Patterson, Chicago.
A. W. Glessner, Chicago.
Ben Cones, Indianapolis.
John F. Hale, Camden, N. J.
Wm. Bronaugh, Chicago.
S. R. Lewis, Chicago.
William Ritchie, New York.
A. C. Burdick, Seattle, Wash.
O. Monett, Chicago.
Chas. E. Warsop, Chicago.
A. G. Cripps, Akron, O.
George Mehring, Chicago.
Eugene Bradley, St. Louis.
Geo. H. Kauffman, Chicago.
Robert L. Gifford, Chicago.
F. Van Inwagen, Chicago.
R. B. Hayward, Chicago.
B. Natkin, Chicago.
Harry de Joannis, Chicago.
Geo. W. Wood, Chicago.
J. P. Morley, Chicago.
Theodore Weinshank, Indianapolis.
Mrs. Theodore Weinshank, Indianapolis.
Miss Anna Weinshank, Indianapolis.
Mrs. W. Adams, Indianapolis.
J. H. Martin, Jr., New York.
E. Sugerman, New York.
A. N. Goff, Chicago.
H. R. Putland, Chicago.
Frank M. Bailey, Chicago.
J. F. Wing, Chicago.
H. Ehrlich, Chicago.
Geo. H. Kirk, Chicago.
J. M. Stannard, Chicago.
Henry H. Lee, Springfield, Mass.
Albert Scheible, Chicago.
Daniel Stern, Chicago.
Fred P. Bird, Chicago.
H. B. McLelland, Chicago.
Geo. M. Tait, Chicago.
Mrs. Geo. M. Tait, Chicago.
Mrs. Thomas Tait, Moline, Ill.
Joseph G. Hayes, Indianapolis.
R. M. Stackhouse, Chicago.
G. G. R. Tratman, Chicago.
A. F. Sterrett, Chicago.
H. A. Miller, Chicago.
E. C. Carey, Chicago.
R. W. Hillman, Chicago.
B. T. Gifford, Chicago.
A. T. Clark, Chicago.
C. E. Wright, Chicago.
J. H. Kitchen, Kansas City, Mo.
Chas. F. Newport, Chicago.
H. Murell, Stockholm, Sweden.
F. S. Whitelaw, Chicago.
Mrs. Harry de Joannis, Chicago.
Miss de Joannis, Chicago.
Mrs. J. Sears, St. Louis.
J. B. Gardner, Jr., Chicago.
W. B. Graves, Chicago.
E. W. Brady, Chicago.
Fred. B. Orr, Chicago.
C. G. Rood, Chicago.
James F. Hess, Chicago.
A. S. Cameron, Chicago.
Wm. H. Chenoweth, Jr., Chicago.
G. M. Proudfoot, Chicago.
J. F. Capron, Chicago.
R. H. Kuss, Chicago.
R. L. Eddy, Chicago.
A. H. Schroth, Chicago.
W. A. Cameron, Chicago.
J. F. [illegible], Chicago.
M. F. Moore, Kewanee, Ill.
H. E. Pursell, Kewanee, Ill.
Miss D. Hayes, Indianapolis.
E. N. Murphy, Chicago.
R. Collamore, Detroit, Mich.
R. G. Rosenbach, Chicago.
Ben Nelson, Chicago.
[illegible], Chicago.
Francis H. McGuire, Rockford, Ill.
H. W. [illegible], Chicago.
H. R. Dillon, Chicago.
A. W. Boylston, Chicago.
J. M. [illegible], Chicago.
Wm. M. Scudder, Chicago.
Mrs. Geo. H. Kirk, Chicago.
Dr. W. F. Colbert, Philadelphia.
M. F. Thomas, Chicago.
Chas. K. Foster, Chicago.

NEW MEMBERS ELECTED

P. A. Bates, consulting engineer, 2 Rector street, New York.

William H. Chenoweth, Jr., Warren Webster Co., Chicago.

S. F. Gardner, Standard Engineering Co., Washington, D. C.

Joseph Graham, Editor *Engineering Review*, New York.

G. T. Hill, General Fire Extinguisher Co., Warren, O.

E. C. Hinkle, President, Atlantic Heating and Engineering Co., Trenton, N. J.

P. A. Hoffman, B. F. Sturtevant Co., New York.

C. R. Honiball, C. R. Honiball Co., Liverpool, England.

N. K. Howard, Consulting Engineer, with Geo. H. Wentz, Lincoln, Neb.

W. P. Klobukowski, 71, Jerozolimska, Warsaw, Poland.

J. I. Lyle, General Manager, Carrier Air Conditioning Co., New York.

F. A. Miller, Supervising Architect's Office, Treasury Department, Washington, D. C.

M. P. Miller, Warren Webster & Co., Camden, N. J.

W. R. Murphy, General Manager, American Heating and Ventilating Co., Richmond, Va.

O. E. Polglase, Westinghouse, Church, Kerr & Co., New York.

C. L. Reeder, consulting engineer, Baltimore, Md.

Arthur Ritter, American Blower Co., New York.

H. C. Russell, Supervising Architect's Office, Treasury Department, Washington, D. C.

W. T. Smallman, treasurer, Isaac Coffin & Co., Boston.

Robert Thomson, Thomson & Homer, Winnipeg, Man.

C. W. Williams, Williams & Cole, Boston, Mass.

H. L. Williams, President, American Warming and Ventilating Co., Pittsburg.

ASSOCIATES

W. G. Culbert, McCrum-Howell Co., Philadelphia, Pa.

Joseph McCusker, Portland, Ore.

C. H. Spiehler, heating engineer, Dayton Lighting Co., Dayton, O.

E. J. Treat, Autoforce Ventilating System, New York.

Social Features of the Meeting

True to their reputation the members of the Illinois Chapter of the Heating Engineers' Society filled every spare moment of the meeting with a delightful series of diversions. The entertainment programme was in the immediate charge of Samuel R. Lewis, W. L. Bronaugh and L. C. Soule, of the Illinois Chapter.

Touring cars were at the disposal of the members and guests throughout the meeting; a considerable number arrived on the evening preceding the opening session in time to enjoy a spin, which was a most grateful relief from the sweltering weather conditions prevailing at the time.

While the first day's session was in progress the visiting ladies were taken to the Marshall Field department store. Here tea was served with the compliments of the Illinois Chapter. In the evening the entire party dined on the roof garden of the La Salle Hotel, where the pleasures were prolonged to a late hour.

The following afternoon, after the close of the morning session, automobiles were in waiting to take the party through Chicago's twenty-five miles of parks and boulevards. This trip was made under ideal weather conditions and was a treat that will not soon be forgotten by those who were so fortunate as to be present. The party afterwards visited the plant of the Sears-Roebuck Co.

A very full day was capped with a moonlight sail on Lake Michigan on the steel steamer, "Theodore Roosevelt." Nearly three hours were spent on the lake, the steamer taking a course of some ten miles towards the center of the lake and back.

Although the meeting had come to final adjournment, many stayed over until Saturday to join the parties that inspected the mechanical equipments of the La Salle and Blackstone Hotels. Before the meeting adjourned, however, a cordial vote of thanks was extended to the Illinois Chapter and its members for their bounteous hospitality.

$8,200,000 Federal Heater Company

Announcement has been made of the formation of the Federal Heater Co., with a capital of $8.200,000. The company is a merger of seven different concerns engaged in the manufacture of various kinds of heating apparatus. The headquarters will be in Chicago.

The constituent companies of the new merger are the International Heater Co., Utica, N. Y.; the Peck-Williamson Co., Cincinnati, O.; the L. J. Mueller Furnace Co., Milwaukee, Wis; the Twentieth Centuhy Heating and Ventilating Co., Akron, O.; the Henry & Scheible Co., Cleveland, O.; the Quaker Mfg. Co., Chicago, and the Ideal Furnace Co., Detroit, Mich.

The combined companies produce steam and hot water boilers for heating purposes, designed for both coal and gas, warm air furnaces and tank heaters. As a result of the consolidation the Federal Heater Co. will have an annual output of 40,000 heaters.

The capital stock is divided into $4,000,000 7 per cent. cumulative preferred and $4,200,000 common. Most of the capital stock has been taken by plant owners in payment for their properties. A relatively small amount of cash is being used in the merger. About $1,500,000 of the preferred stock will be offered simultaneously in Chicago, New York, Cincinnati and Detroit. This will be sold at par with a bonus of 10 per cent. in common stock.

A. W. Williamson, president of the Peck-Williamson Co., will be president of the new corporation; L. J. Mueller, Jr., and John Kerch will be vice-presidents. The secretary will be D. M. Compton and the treasurer, F. H. Moore, of the International Heater Co.

The company starts without any bonds or debts. It is announced that the earnings of the constituent companies in 1910 were equal to $450,000 net. For 1911 the earnings are estimated to be $550,000. After deducting $280,000 for the preferred dividend there would remain $270,000; applicable to the common stock, being 6.4 per cent. of that issue.

The following statement of assets and liabilities appears in the prospectus:

ASSETS		
Plants, etc.		$6,310,693
Merchandise (not including that contracted for to be valued by inventory)	$485,848	
Accounts receivable (not including those to be retained by certain companies)	443,458	
		929,306
Cash acquired with assets of Companies	$60,000	
Cash to be paid in from sales of stock for additional operating capital	900,000	
		960,000
Total		$8,200,000
LIABILITIES		
Preferred stock		$4,000,000
Common stock		4,200,000
Total		$8,200,000

$800,000 common stock is retained in the treasury to provide for increase of business.

James D. Hoffman, professor of mechanical engineering at Purdue University, Lafayette, Ind., has been appointed head of the engineering department of the University of Nebraska at Lincoln, Neb. Professor Hoffman is well known in the heating and ventilating profession and is a past president of the American Society of Heating and Ventilating Engineers. He is receiving congratulations from his many friends on his call to the larger work he will undertake at the University of Nebraska.

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CANADIAN Society of Sanitary and Heating Engineers is the new title that has been adopted by the National Association of Master Plumbers and Steam Fitters of Canada. We have already referred to what seems to us an anomaly in thus characterizing an organization made up in such large part of master plumbers. We can think of no more pungent comment, however, than that voiced by the *Plumber and Steamfitter*, of Canada, in its statement that "on Wednesday morning at ten o'clock one hundred master plumbers entered the convention hall. At 12:30 one hundred sanitary and heating engineers left the hall."

NOW that the proposed plan to enlarge New York's subway is assuming definite shape the matter of its ventilation is being taken up by interested citizens with a view of preventing, if possible, the serious air conditions, both as to high temperature and odors, that prevail in the present subway. It may not be generally known that the extensions as planned embrace more mileage than the whole of the present system so that the subject assumes an importance equal to, if not greater than, that of the ventilation of the original subway itself. Bitter experience, moreover, has taught the thousands of patrons that now is the time to secure favorable action rather than after the new subways are built. For years the public has been treated to the makeshift and futile efforts to procure cool, or, at least, fresh air in the present tubes, although at the present time the subway is noticeably warmer and more malodorous than at any previous time in its history. The most sensible suggestion for securing adequate ventilation in the new subway, and one which has already won the endorsement of part of the public press, has been proposed by Albert E. Henschel, formerly secretary of the Greater New York Charter Commission. Mr. Henschel's proposition is the appointment, by the city's Board of Estimate and Apportionment, of a commission of experts in sanitary science and ventilation to advise the board on this question.

IT IS a pleasure to note that Ohio has recognized the importance of compulsory ventilation of buildings to the extent that its new building code provides for the mechanical ventilation of its theatres and other places of assembly. We shall publish in the August issue that portion of the code bearing on ventilation.

Central Station Heating

4.—OPERATION

By Byron T. Gifford

(Previous articles in this series: "Pipe Line Losses," April, 1911; "Rates," May, 1911; "'Ready to Serve' or 'Maximum Demand' Rate," June, 1911.)

Pressure Required at the Station

This pressure is dependent upon the pipe line sizes, the insulation and the grade of the pipe line in steam heating plants. In hot water plants it is dependent upon the pipe line sizes, the insulation, and the elevation of the heating station relative to the buildings being served.

After a plant is in operation it is an easy matter to determine the drop in pressure from one point to another and under actual operating conditions. Having determined the point on the line where the greatest drop in pressure occurs, we can determine the pressure necessary to carry at the station in order to have the required pressure at the weakest point. So much is very easy, but to determine whether or not excess pressure is being carried in order to create the necessary pressure at the weak point is quite another problem and is not so easy to determine.

Causes That Demand Excess Pressure in Steam Heating Mains

Insufficient pipe sizes is one of the most common causes of bad pressure conditions. Often a given line has developed more business than it can handle economically and excessive pressure is required to make this line carry sufficient steam to suppy its connected load.

Improper line drainage also causes a bad pressure condition. For example, a line not properly graded, with a pocket in it, will cause no end of trouble. The pocket will fill with condensation and, even though a water hammer does not develop, the free area of the pipe is reduced, the friction increased and, consequently, the pressure at the station must be increased to compensate for this additional friction loss. The condition is often found in service lines and should be guarded against and, if possible, located and remedied by means of regrading the line or by installing additional bleeder connections.

Causes That Demand Excess Pressure in Hot Water Heating

In central station hot water heating we are not troubled so much with pockets as in steam, but the writer believes them as serious in one case as in the other. Air pockets do the damage in hot water heating and every high point should be vented and kept free from air. In this case the

pipe, or a part of it, fills with air and the flow of water is restricted, requiring a greater pressure in order to give proper circulation.

Insufficient pipe sizes is also a cause of excess pressures being necessary. This defect is often caused by the territory out-growing the pipe line.

To determine whether excess pressures are being carried, refer to your pipe capacity tables and find out if the conditions you are experiencing in your pipe line conform to the table. If not, look for the trouble.

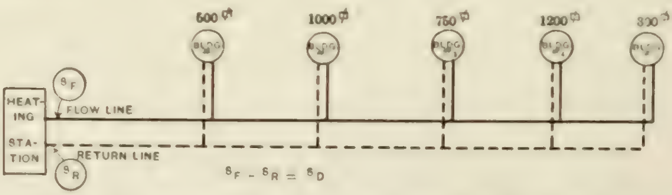
If your operating and test observations show that your pipe line is not demanding an excessive pressure, you can then carry the lowest possible pressure that will give you 1 lb. (if steam) and 1 lb. difference in pressure (if water) at the weakest point on the line.

In hot water heating, as already stated, the difference in pressure is what you need, the circulating pressure or, as it is often called, the differential pressure. For example, the pressure on the flow line is 40 lbs. and on the return line 30 lbs., thereby making the differential pressure 10 lbs. There must be at least 1 lb. differential pressure at the entrance of the building and each and every radiator must be full of water in order to heat a building properly. Therefore, the return pressure at the building should be sufficient to raise the water to the top of the building and the flow pressure should be at least 1 lb. more.

Locate the weakest point in this connection and be guided accordingly. As a rule, the weakest point will be at the end of some long lateral.

Pumpage in Hot Water Heating

One of the most important points in hot water heating is the amount of water pumped per square foot of radiation, per unit of time. Excessive pumpage means a waste of power and is a sure sign of poor operating conditions. To remedy this trouble it is necessary to regulate the amount of water passing through each building. To explain more fully this point we will study the following drawing.



We will assume that we are carrying a flow pressure at the station (SF) of 45 lbs. and a return pressure (SR) of 30 lbs. giving us a differential pressure (SD) of 15 lbs. at the station. Under these conditions we find by test that our pressure conditions would be as follows:

Position	Flow Pressure, pounds per square inch	Return Pressure, pounds per square inch	Differential Pressure, pounds per square inch
Station........	45	30	15
Building No. 1..	44	31	13
Building No. 2..	42.5	32.5	10
Building No. 3..	41	34	7
Building No. 4..	39.5	35.5	4
Building No. 5..	38	37	1

Now the problem to be solved is, whether or not we have excess pumpage. We know that under the conditions we have as low a differential (SD) as we possibly can have and still have one pound difference at Building No. 5. If we are pumping too much water it is going through the four jobs nearest the station.

In order to determine this it is necessary to measure the amount of water flowing through each job. This can be easily done by means of a hot water disc meter. The result will be sufficiently accurate to answer our purpose.

Pumpage Necessary

The amount of water necessary to pump per square foot of radiation per hour seems to be an unsettled question. One thing is certain; the water carries the heat and 1 lb. of water will deliver as many heat units as it loses in degrees Fahrenheit going through the radiation.

If the water loses 20° F, it will emit 20 B.T.U. per pound. If the radiation is figured so as to give off 180 B.T.U. per square foot per hour at zero, outside temperature, it would require 9 lbs. of water per square foot per hour. If we regulate the flow of water through each square foot of radiation so as to omit 30 B.T.U. per pound, it would require 6 lbs. of water per square foot of radiation per hour, at zero outside.

When the temperature outside is higher, the temperature of the water will be lower and consequently the water will not lose as much heat per pound. The amount of water pumped can be reduced some, but not to any considerable extent, unless temperature regulation of some kind is used in the buildings.

Regulating the Flow of Water

We will take it for granted that we need 6 lbs. of water per square foot of radiation per hour at Building No. 1. This building has 500 sq. ft. of radiation and consequently would need 3,000 lbs. of water per hour. The differential pressure at Building No. 1 is 13 lbs. The opening necessary to supply this amount of water at this differential pressure is a 5-16-in. hole.

Building No. 2, with 1,000 sq. ft. and 10 lbs. differential pressure, would require a 13-32-in. hole.

Building No. 3, with 750 sq. ft. and 7 lbs. differential pressure, would require a 13-32-in. hole.

Building No. 4, with 1,200 sq. ft. and 4 lbs. differential pressure, would require a 5-16-in. hole.

Building No. 5, with 300 sq. ft. and 1 lb. differential pressure, would require a 13-32-in. hole.

These chokes or retarders should be placed in the return line just before it leaves the building, or on the return of each belt. The placing of these requires judgment and experience.

The total area of the chokes is found to be:

Building No. 1	5/16 in.
Building No. 2	13/32 in.
Building No. 3	13/32 in.
Building No. 4	5/16 in.
Building No. 5	13/32 in.
	1-27/32 in.

The service lines run to these buildings should be not less than 1¼-in. in diameter, even though that size is too large, for at some future time the amount of radiation might be increased and the large service line will be sufficiently large to take care of the additional load.

With this method of regulation, perfect control cannot be accomplished, but a great benefit can be derived by using it.

A number of flow controlling valves have been devised and are more or less valuable to the operating man. The cost of these valves is the only thing that stops their universal adoption. It costs comparatively little to regulate with the chokes or retarders and, for that reason, this method is much more popular. The author has used a cast-iron choke, with a hole drilled through it, and has found it to be very well adapted to this use. It is noiseless and easily made.

The automatic flow controlling valve has the advantage by being self-adjusting, while the choke system is fixed for one condition. For example, assume that an 800 sq. ft. job is connected to the system shown before, between Buildings No. 1 and No. 2. The connecting of this job will affect the pressure necessary to carry at the station and will affect the size of the choke in Building No. 1. It would have to be just a little smaller, because, owing to the necessity of pumping more water, a larger differential pressure is necessary and, consequently, more water will pass through Building No. 1 than is necessary, unless the choke is made smaller. If the additional building is con-

nected and the pumpage is not increased, the balance of the system will be affected by not getting sufficient water.

In a case like the above, the flow controlling valve would adjust this condition automatically, because it allows only a certain amount of water to circulate through each building, no matter how much too great the differential pressure may be. On the other hand, disc or choke control has a slight advantage over the automatic valve control in one way. In choke control the pumpage can be momentarily increased on the whole system whenever it is advantageous to do so, which is sometimes the case, especially in rapidly falling temperature. By increasing the pumpage we increase the number of B.T.U. given off by each square foot of radiation, because the number of B.T.U. emitted is proportional to the difference between the room temperature and the average temperature of the radiator.

The faster the water circulates through the radiator the less heat each pound of water will emit and the less each pound of water emits, the hotter is the water leaving the radiator and, consequently, the higher the average temperature of the radiator, which, of course, means that each square foot of radiation will emit more heat per unit of time. This is an advantage when a severe and rapid drop in temperature is experienced. This is especially true in systems controlled by thermostats, where, by increasing the heat emission, all thermostats, almost to the shutting off place, will shut off and decrease the load on the plant temporarily and materially help in raising the temperature of the circulating water.

(Mr. Gifford's next article will appear in the August issue.)

Color Scheme for Identification of Power House Piping

A definite plan for identifying power house piping by means of distinguishing colors is contained in a report recently submitted to the American Society of Mechanical Engineers by a committee on the subject. This matter, it will be remembered, was first prominently agitated by the late William H. Bryan, of St. Louis, several years ago, and the present recommendations are the result of several committees' efforts in this direction. Following are the recommendations in detail:

In the main engine rooms of plants which are well lighted, and where the functions of the exposed pipes are obvious, all pipes shall be painted to conform to the color scheme of the room; and if it is desirable to distinguish pipe systems, colors shall be used only on flanges and on valve-fitting flanges.

In all other parts of the plant, such as boiler house, basements, etc., all pipes (exclusive of valves, flanges and fittings), except the fire system, shall be painted black, or some other single, plain, durable, inexpensive color.

All fire lines (suction and discharge), including pipe lines, valve flanges and fittings, shall be painted red throughout.

The edges of all flanges, fittings or valve flanges on pipe lines larger than 4 inches inside diameter, and the entire fittings, valves and flanges on lines 4 in. inside diameter and smaller, shall be painted the following distinguishing colors, numbered 1 to 12, inclusive:

DISTINGUISHING COLORS TO BE USED ON VALVES, FLANGES AND FITTINGS ONLY

Steam Division: High pressure—white. Exhaust system—buff.

Water Division: Fresh water, low pressure—blue. Fresh water, high pres-

sure boiler feed lines—blue and white. Salt water piping—green.
Oil Division: Delivery and discnarge—brass or bronze yellow.
Pneumatic Division: All pipes—gray.
Gas Division: City lighting service—aluminum. Gas engine service—black, red flanges.
Fuel Oil Division: All piping—black.
Refrigerating System: White and green stripes alternately on flanges and fittings, body of pipe being black.
Electric Lines and Feeders: Black and red stripes alternately on flanges and fittings, body of pipe being black.

The committee is composed of H. G. Stott, chairman; F. R. Hutton, I. E. Moultrop, H. P. Norton and J. T. Whittlesey.

Current Heating and Ventilating Literature

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from The Heating and Ventilating Magazine *on receipt of the stated price.*

CENTRAL STATION HEATING

Exhaust Steam Heating as Developed by a Large Central Lighting Station. E. Darrow. Illustrated explanation of the system of central station supply of heat used by a company in Indianapolis, Ind. 1200 words. Elec. Wld.—April 6, 1911. 20c.

HEATING OF RESIDENCES

Heating of Residences. D. D. Kimball. Discusses the importance of ventilation in the home, the control of temperature, humidity, heating system, etc., 2500 words. Ins. Engng.—March, 1911. 40c.

SHOP VENTILATION

Dust Collecting Appliance in Cotton Mills. Illustrates and describes improvements introduced for stripping and extraction of dust of a carding engine, and protection from accidents. 2500 words. Engng.—April 14, 1911. 40c.

Ohio's New Building Code Regulates the Heating and Ventilation of Theatres

Included in Ohio's new building code, which recently became a law, are special provisions regarding the heating and ventilation of theatres. The code is designed to regulate the construction, repair and alterations and additions to public buildings and other buildings in the state. Its provisions are to be enforced by the state fire marshal, the chief inspector of workshops and factories and the state board of health.

According to a ruling of Attorney-General T. H. Hogan, the new code does not apply in municipalities which now have sufficiently stringent building codes in force.

In the construction of theatres the code provides that furnaces, hot water heating boilers and low-pressure steam heating apparatus, breeching, fuel room and firing room must be enclosed in an approved fireproof heater room and all openings in same are to be covered by approved self-closing fire doors. The heating system must of sufficient capacity to heat all parts of the building to a temperature of 65 degrees Fah.

The ventilation requirements are especially interesting. The system of ventilation must provide for a change of air in all parts of the building at least six times each hour. All assembly halls and theatre auditoriums must be supplied with fresh warmed air to the amount of 1200 cu. ft. per hour for each person. The system may be either a gravity or mechanical furnace system, gravity indirect steam or hot water, or a mechanical indirect steam or hot water system. Fresh air must be taken from outside of the building and the recirculation of vitiated air is forbidden. No floor register for heating or ventilating shall be placed in any aisle or passageway.

Legal Decisions

Estoppel by Decree from Denial of Waste of Heating Company's Gas

In a suit by a heating company to restrain a gas company from wasting gas derived from a field from which the heating company obtained its natural gas, by the operation of a lampblack factory, it was adjudged that the gas company did operate such factory and it was enjoined from wasting the gas in such operation. In a subsequent action by the heating company to recover damages alleged to have been sustained by the heating company from such waste of gas it was held that the gas company was estopped by the decree in the prior suit from thereafter litigating the fact that they operated the factory.—Louisville Gas Co. vs. Kentucky Heating Co., Kentucky Court of Appeals, 134 S. W. 205.

Rescission of Contract of Sale by Seller's Actions

A seller of water heaters made contracts with a large number of retailers, each order containing the condition, "These goods shipped at this price only upon condition that number sufficient to obtain quantity discount is purchased in city." Before the contract was executed the parties mutually agreed that the entire lot of heaters should be delivered to

a heating company, which would distribute them and receive payment. After delivery the seller wrote to the buyers telling them to pay the heating company. In an action by the seller against one of the purchasers it was held that by the acts of the seller any indebtedness which might have accrued to him was released and there was a complete novation of the contract.—Michigan Stove Co. vs. A. H. Walker & Co., Iowa Supreme Court, N. W. 130

No Liability of Heating and Ventilating Contractors' Surety Beyond Terms of Bond

A board of education contracted with an engineering company to install the heating and ventilating equipment of a public school building. A guaranty company become surety on the contractor's bond. The contractor did not perform his undertaking, but a corporation subsequently formed did so. No contract appeared between this corporation and the contractor or the board of education. A company furnished and installed the covering for the steam pipes, part of the heating apparatus, under a contract with the corporation alone. The corporation became insolvent and omitted to pay for the material and labor employed in the pipe covering. The company sued the surety on the bond of the original contractor. It was held that the company could not recover against the surety, because it did not appear that the material was furnished or the labor performed under a contract with, or at the instance or request of, the original contractors, whose conduct was assured by the surety, or with the board of education, which was authorized to complete any portion of the work not installed by the contractors.—Board of Education of City of St. Louis vs. United States Fidelity & Guaranty Co. (Missouri), 134 S. W. 18.

Federal Furnace League

At a special meeting of the executive committee of the Federal Furnace League, held in Philadelphia June 19, reports were received on the official testing of furnaces, and the work of the engineering department was reviewed and approved. The text and rules of the book, entitled "The Federal System of Heating and Ventilation" were reviewed and certain revisions were ordered, chiefly in the direction of simplification of the rules.

It is expected that the testing of the furnaces of the members will be completed, and that the Federal System book will be issued during the coming autumn. The furnace industry, it is stated, will then have a standard, authoritative system of installation, with the capacity ratings of the leading furnaces determined by actual tests of the apparatus. The league reports the enthusiastic support of its membership in the plan for establishing a standard system of installation and of capacity ratings.

The executive committee accepted the invitation of the National Association of Sheet Metal Contractors to attend the annual meeting of that organization at Omaha on August 8-11. The league will accordingly be represented at that meeting by its engineer, Dr. Wm. F. Colbert; its secretary, Wilson Ferguson, and by a delegation from its executive committee and membership.

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

New York State Association

At the annual meeting of the New York State Association of Master Steam and Hot Water Fitters, held at the headquarters of the National Association, in New York, the following officers were elected for the ensuing year: President, Samuel Wright, Buffalo; vice-president, Edward F. Joy, Syracuse; secretary-treasurer, William H. Curtin, New York; sergeant-at-arms, William Scollay, New York; board of directors, Charles Geiger, Buffalo; Frank H. Falls, Rochester; Frank Leavery, Syracuse; William H. McKiever, New York; Ernest C. Seward, New York; Samuel Wright, Buffalo; Edward F. Joy, Syracuse; William H. Curtin, New York. Subsequently the board of directors elected Charles Geiger chairman and H. B. Gombers, New York, recording secretary.

Pennsylvania State Association

Following are the new officers of the Pennsylvania Association of Master Steam and Hot Water Fitters, elected at its fifteenth annual convention Pittsburg: President, William P. Thompson, Philadelphia; vice-president, P. F. Maginn, Pittsburg; secretary, M. G. Sellers, Philadelphia; treasurer, Harry G. Black, Philadelphia; sergeant-at-arms, John C. F. Trachsel, Philadelphia; executive committee, Joseph A. Langdon, Pittsburg; B. Harold Carpenter, Wilkes-Barre; Stewart A. Jellett, Philadelphia; John R. Flinn, Johnstown; C. Ed. Hantz, York.

Philadelphia Local Association

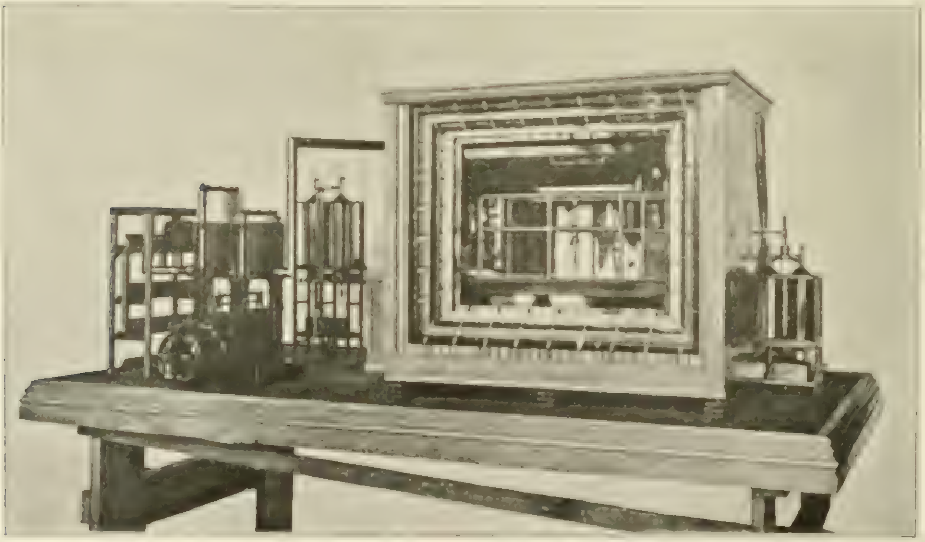
Following are the officers of the Philadelphia Master Fitters' Association elected at its recent annual meeting: President, Robert J. Hoben; vice-president, John L. Moyer; treasurer, Edw. R. Steinmetz; secretary, M. G. Sellers; executive committee, John L. Moyer, Stewart A. Jellett and William P. Thompson.

A Respiration Calorimeter for Animals

An apparatus that has been in use for some time by the Pennsylvania State College Institute of Animal Nutrition to determine the nutritive values of different animal foods offers many features of interest to the heating and ventilating engineer. It is a respiration calorimeter, similar in many respects to that used at Wesleyan University, in which men were the subjects tested. By means of the apparatus and its accessories it is possible to determine exactly, not only the amounts of digestible matter and potential energy contained in animal foods, but also the use which the organism makes of these. The experiments, which were made under the supervision of Dr. H. P. Armsby, director of the Pennsylvania Experiment Station, included chemical analyses of the feeding stuffs used and of the visible excreta, the determination of their heats of combustion, a determination of the gases given off in the respiration of the animal, and the amount of heat which the animal produces. The apparatus is large enough for experiments upon fully mature cattle.

While no figures are given regarding the effects on the air of the respiration of the animal, the air supply being 700 liters (17.64 cu. ft.) per minute, the details of construction of the calorimeter itself are important and valuable because the apparatus in its present form represents the solution of several problems in connection with the tests. As now arranged, the respiration calorimeter takes care of practically every condition, and is, therefore, a standard type of apparatus for use in this class of work, including respiration tests.

The general construction of the respiration chamber is shown in the accompanying illustration. The chamber is constructed of sheet copper, and measures 6 ft. by 10 ft, 4 in. and 8 ft. high. A platform 21 in. above the base of the chamber carries the stall in which the animal stands. Beneath the rear portion of this stall is a small chamber of sheet copper about 34 by 67 in., entirely shut off from the rest of the respiration chamber except for two holes through the platform, and having a separate air-tight door. Through one of the holes mentioned a rubber tube leads from the urine funnel to a receptacle of tinned copper; to the other hole is attached a large rubber duct covering the hindquarters of the animal, and underneath it is placed a galvanized iron box, tightly pressed against the lower side of the platform, to receive the droppings of the animal.



MODEL OF RESPIRATION CALORIMETER SHOWING GENERAL PLAN AND DETAILS OF CONSTRUCTION

At the other end of the platform is the feed box. This is provided with an air-tight cover, which can be opened or closed by means of a lever operated from outside, and is also provided with an air-tight door. By lowering the cover the feed box can be entirely shut off from the chamber. The air-tight door can then be opened for the introduction of feed or the removal of residues, the door closed and the lid again lifted. The arrangement constitutes, in brief, an air lock. The water supply is introduced into a small drinking basin at the side of the feed box by means of a pipe carried through the calorimeter wall, the water

being weighed in and any excess removed by drawing the water in the pipe down to a fixed level.

The large door at the rear of the apparatus through which the animal enters and the two small doors giving access respectively to the feed box and excreta have heavy oak frames and are made tight by means of gaskets composed of rubber tubing, the doors being kept in place by means of pressure catches such as are frequently used on large refrigerators.

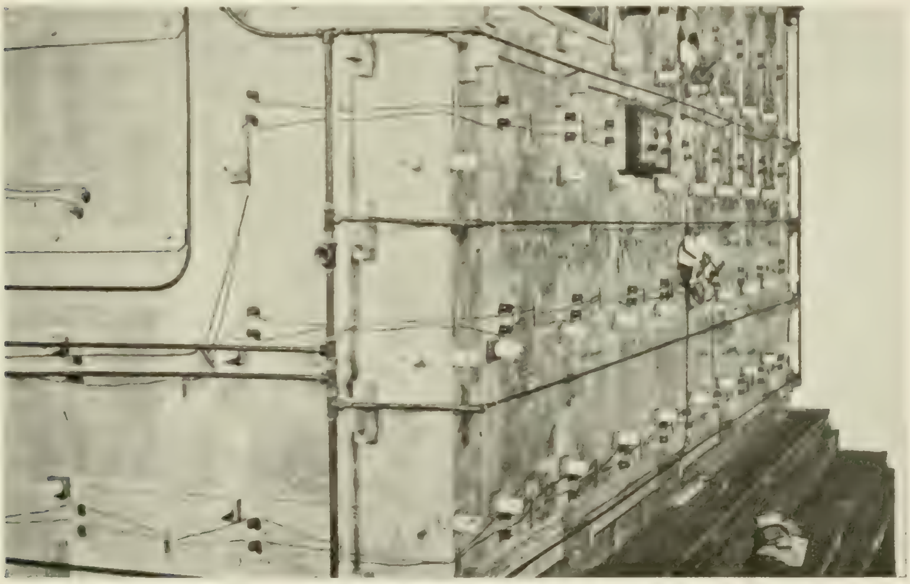
THE RESPIRATION APPARATUS

Through the chamber above described a current of outdoor air is aspirated by means of a special pump, the air first passing over the expansion coils of an ice machine, where most of its moisture is deposited as frost. At the point of entry to the chamber samples are taken alternately by one or the other of two large aspirators of constant flow at the rate of 200 liters in 12 hours. In these samples moisture and carbon dioxide are determined by passing them through U tubes containing sulphuric acid and soda lime.

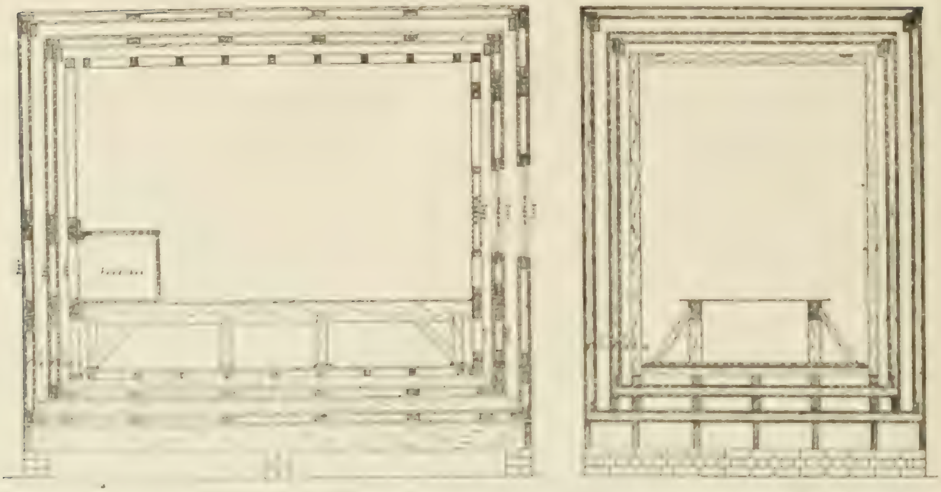
The air leaving the respiration chamber passes first through four large copper cans, standing in wells in a brine bath which is coiled to about —20° C. by means of the ice machine. In these cans the larger share of the moisture of the outcoming air condenses as frost and is subsequently weighed.

From the copper cans the air passes to the meter pump, which serves both to maintain the air current and to measure and sample it. The number of strokes as recorded by a revolution counter, with the corrections for temperature and pressure, gives the total volume of air passing through the apparatus, and the results of the analysis of the ingoing air, calculated upon this volume, give the weight of water and carbon dioxide carried into the apparatus by the current of air.

By means of a shunt valve connected with an ingenious train of gearing one stroke is delivered at regular intervals alternately through one or the other of two special outlets. The pump can be set to deliver thus one stroke in 200, one in 400, or one in 800. The two aliquot samples thus taken are conducted to two large pans having counterpoised rubber covers. From these pans each sample separately is aspirated by means of a subsidiary air pump, and after bubbling through concentrated sulphuric acid contained in a gas washing bottle passes through a set of six large U tubes (27 centimeters), the first two containing pumice stone saturated with sulphuric acid, the second two soda lime, and the last two pumice stone and sulphuric acid. The increase in weight of the flask and the first two tubes gives the amount of water and that of the remaining four tubes the amount of carbon dioxide contained in the samples, and these amounts, multiplied by the proper factor, give the total amounts contained in the outcoming air. Subtracting those contained in the ingoing air, determined as described,



ARRANGEMENT OF HEATING WIRES, COOLING PIPES, ETC., IN ANIMAL RESPIRATION CALORIMETER

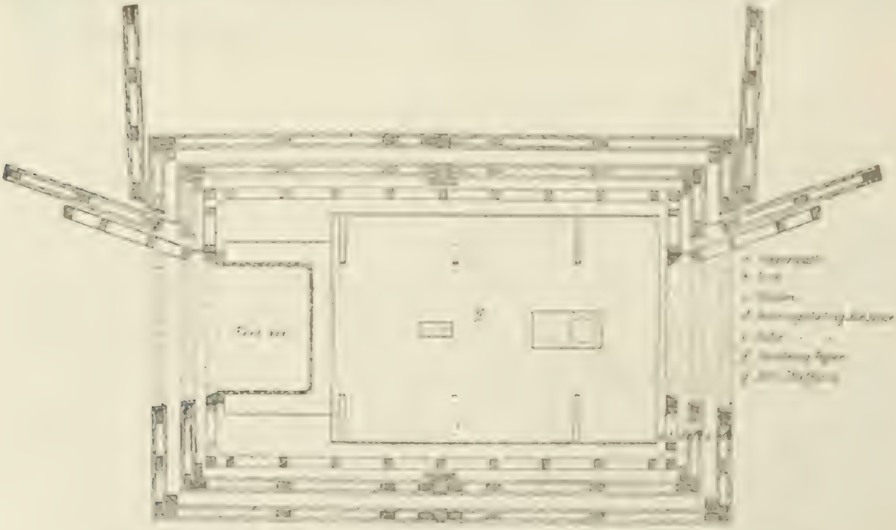


VERTICAL CROSS SECTION, ANIMAL RESPIRATION CALORIMETER

gives the amount added by the animal. Since the composition of the outcoming air has also been determined in samples taken by means of large aspirators (See figure) at constant flow.

The arrangements for determining the heat given off by the animal are in all essentials like those of the Atwater-Rosa apparatus. The heat is absorbed by a current of cold water passing through copper pipes at the top of the respiration chamber, access of air to these pipes being regulated by means of shields which can be raised or lowered by the operator.

The respiration chamber proper of the apparatus is a metallic chamber of the dimensions stated above. Surrounding this, with an air space of 3 in. between is a double wooden wall, which in turn is surrounded by a second wall and air space of 4 in. The walls of the respiration chamber proper are double, the inner of copper and the outer of zinc, with a 3-in. dead air space between, and through these walls are distributed some 300 iron German-silver couples connected in series with a reflecting galvanometer and serving to indicate any difference in temperature between the inner (copper) and outer (zinc) surface. Any such difference is rectified and the walls of the chamber maintained adiabatic by heating or cooling the air space surrounding the zinc wall—the former by means of an electric current through resistance wires and the latter by circulating cold water



HORIZONTAL CROSS SECTION, ANIMAL RESPIRATION CALORIMETER

through brass pipes. The double wooden wall surrounding the metallic chamber also contains a smaller number of iron German-silver couples, and is in its turn kept nearly adiabatic by regulating the temperature of the second air space. By means of very similar devices, the temperature of the ingoing air is maintained the same as that of the outcoming air.

The temperature of the interior of the apparatus is measured by means of a series of copper resistance thermometers connected to a slide-wire Wheatstone bridge, and also by means of two mercurial thermometers. By raising or lowering the shields or varying the flow of water through the absorbers, the rate at which heat is removed through the water current may be so regulated as to keep the temperature of the interior constant within very small limits, while the slight variations are made to balance each other in the course of an experiment, so that there is practically no capacity correction. Under these conditions all the heat evolved by the animal must leave the apparatus either as sensible heat in the water current or as the latent heat of water vapor.

Largest Peat Machine in the Country

A peat machine with a daily excavating capacity of 2,500 tons per working day of two shifts, or about 310 tons of fuel ready for the market, allowing for the proper moisture content, has been built by Peat Industries, Ltd., of Montreal, Can., and is illustrated herewith. Peat Industries, Ltd., has lately been formed under the auspices of the railway builder and mine owner, M. J. O'Brien, who is the president of the company, and L. B. Lincoln, vice-president and managing director.

NEW DEVICES

A New Solder in Paste Form

Solderall, a new kind of iron solder, in the form of paste in a collapsible tube, has lately been placed on the market by the H. W. Johns-Manville Co., New York. It is put up in a manner similar to the familiar tube of tooth paste. In utilizing this new form of solder the surface of the pipe is first scraped with a knife, after which the paste may be squeezed from the tube onto the scraped surface, and a match, candle or torch applied. When the paste becomes hot it fuses and solders in the same manner as the old style soldering stick. Solderall may be obtained from any of the company's branch houses in various parts of the country. The company reports that it has already met with wide approval, especially on account of its convenience, cleanliness and economy.

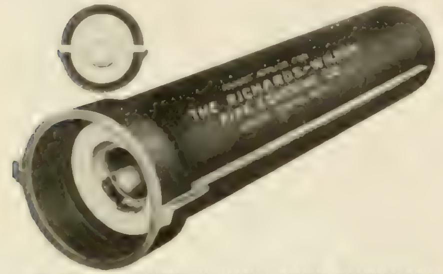
A New Underground Pipe Covering

A new form of pipe covering is known as Ric-wil cement, which is the material used to insulate the Ric-wil vitrified tile casing shown in the accompanying illustrations. This covering, it is stated, has the highest efficiency of any known heat-insulating material. It has also proved a powerful non-conductor of electricity as well as of heat. In use it has been found to be not susceptible to disintegration or loss of efficiency from moisture, and the sectional covering made from this cement does not change its form or

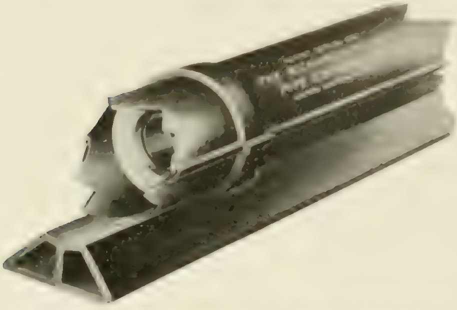
LARGEST PORTABLE PEAT MACHINE IN THE COUNTRY

lose its power after repeated submersions in water.

Recent tests on this form of pipe covering are to the effect that there is practically no difference between the covering when used with or without an air space between the covering and the pipe although it is probable that details of construction can be changed slightly to make the air space more efficient. The insulation tests showed that this type of covering is from 7.45 to 8.7 times as effective as the bare or uncovered pipes in preventing condensation of steam. An interesting result of the test was the discovery that with the Ric-wil covering the higher the steam pressure and steam temperature, the better the efficiency of the covering. The Ric-wil pipe covering is made by the Richards-Wilson Pipe Covering Co., Grand Rapids, Mich., and is sold through the Central Station Steam Co., Detroit, Mich.



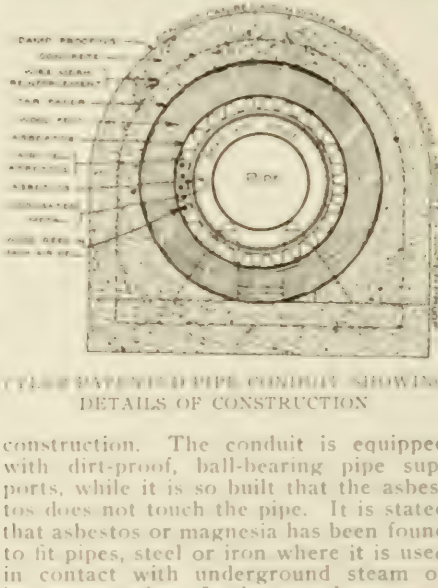
RIC-WIL UNDERGROUND PIPE COVERING



RIC-WIL UNDERGROUND PIPE COVERING WITH BASE DRAIN

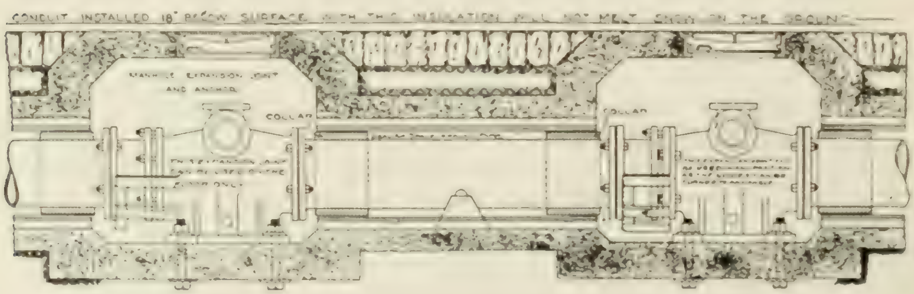
Tyler Pipe Conduit and Tunnel Construction

A number of interesting devices are included in the steam and hot water specialties lately placed on the market by E. B. Tyler, 301 House Bldg., Pittsburg, Pa., and in the Tyler patent system of underground conduit and tunnel construction. The accompanying illustrations show this type of pipe conduit, as well as typical views of the Tyler tunnel construction. The conduit is equipped with dirt-proof, ball-bearing pipe supports, while it is so built that the asbestos does not touch the pipe. It is stated that asbestos or magnesia has been found to fit pipes, steel or iron where it is used in contact with underground steam or hot water mains. In the tunnel construction use is made of the Tyler pipe support, designed to economize space.



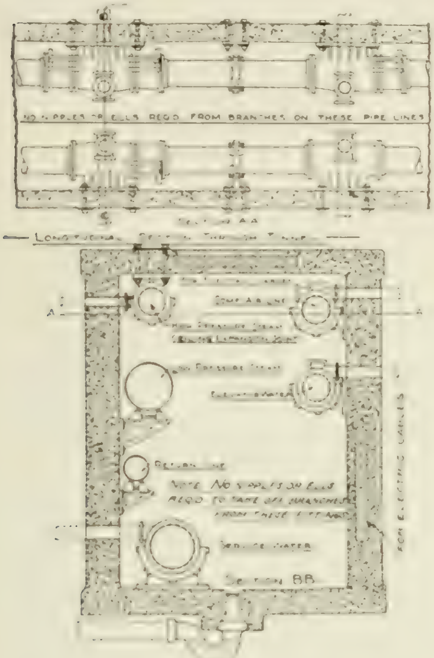
TYLER PATENTED PIPE CONDUIT SHOWING DETAILS OF CONSTRUCTION

The longitudinal sectional view of the conduit as installed shows the Tyler anchor and expansion joints, which are made with either side or top outlets, as required. They also have a pocket for removing the condensation. Emphasis



TYPICAL SECTION OF TYLER UNDERGROUND PIPE CONDUIT

is laid on the fact that these fittings require no nipple or ells from which to take a branch, thus saving labor as well as head room in a tunnel or manhole.



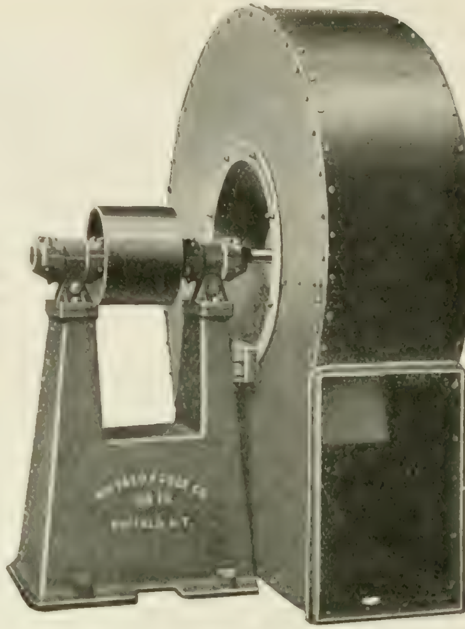
[illegible] CONSTRUCTION

The expansion joint is equipped with a bored guide for the flange and the construction of the conduit permits the steam pipe to be rotated in their conduits when necessary, thus giving a new surface for the drain back of the condensation.

Running Record of New Buffalo Exhaust Fan

An interesting record for economy in power consumption is reported by the Buffalo Forge Company, Buffalo, N. Y., in connection with three double exhaust fans of the slow-speed, multiblade type. These fans have been in use for some time in the plant of the Cutler Desk Co., having replaced three double fans of another make. Performing the same amount of work, the new Buffalo fans consumed 21 H. P. as against 40 H. P. for the former installation. Figuring power at $35.00 per horsepower per year, this will be seen to effect a saving of $665.00 per year with the three fans, which, applied to the purchase price, was found to exceed a return of 100 per cent. per annum on the investment.

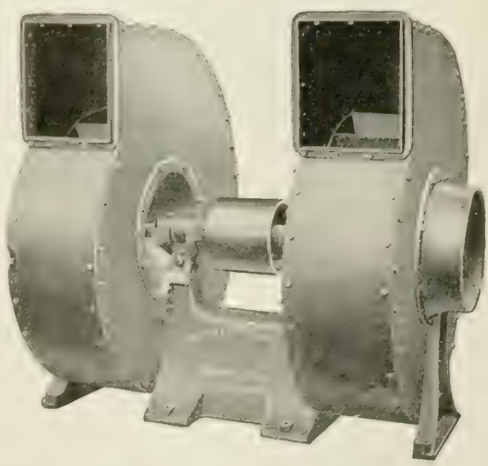
The high efficiency is attributed to the design of the multiblade fan wheel and to its proportions, permitting of maximum efficiency at speeds averaging fully



SLOW SPEED MULTIBLADE BUFFALO EXHAUST FAN OF SINGLE TYPE

30 per cent. below the normal for exhaust fans. The applications of this type of fan are almost as numerous as those of standard design. They are made single or double in sizes from 30 inches to 80 inches in diameter, for pressures from 1 to 6 oz. Like the Buffalo standard exhaust fans, they are made with reversible housings.

Barton Expansion Automatic Steam Trap, made by the Automatic Steam Trap & Specialty Co., Cleveland, O., is a unique device which is illustrated and



SLOW SPEED MULTIBLADE BUFFALO EXHAUST FAN OF DOUBLE TYPE

described in a newly issued circular. The trap consists of an inner and outer tube and is a radical departure from the familiar float and bucket types. The outlet end of the inner tube bears the valve seat. When the steam enters the inner tube it expands and seats itself against the valve disc, thereby sealing the trap. When condensation takes place, the inner tube contracts, allowing the water to escape. The outer tube is also an expansion tube, making the trap useful both for gravity and vacuum heating systems. Pp. 24. Size 6 x 9 in.

Wanted

Position wanted by heating and ventilating draftsman and estimator. Steam, hot water and fan systems. Eastern city preferred. Also heating supply salesman. At present employed. Address Estimator, care of Heating and Ventilating Magazine.

Advertisers' Index

TRADE AND MISCELLANEOUS NOTES

Miscellaneous Notes

Grand Rapids, Mich.—Recently the board of education let a contract amounting to $20,000 for the overhauling and installation of a new heating and ventilating system in the principal school buildings. The board now finds that the charter forbids the issuing of bonds, and no money is on hand to carry out the contracts made.

Manufacturers' and Dealers' Protective Association, at its recent annual meeting in New York, elected the following officers for the ensuing year: President, W. M. Seymour; vice-president, J. S. Simmons; second vice-president, G. D. Dorsey; treasurer, L. O. Koven; secretary, F. R. Huntington, 20 Broad street, New York City; assistant secretary, Samuel J. Bailey. Executive committee: W. M. Seymour, J. S. Simmons, G. D. Dorsey, L. O. Koven and P. H. Seward. Trustees: W. M. Seymour, J. S. Simmons, G. D. Dorsey, L. O. Koven, P. H. Seward, A. F. Boardman, F. A. Buckman, Max Goebel, Walter S. Gibbs, Martin Behrer, J. H. Borton, Fred. Lowe and J. F. Hall.

Iron City Heating Co., Pittsburg, Pa., announces that William G. Boyle, formerly consulting engineer for the estate of Henry W. Oliver, will hereafter be associated with its organization. The Iron City Heating Co. was established over nineteen years ago, installing steam and electric power, steam and hot water heating and ventilating systems.

Mexico, Mo., is considering a proposition made by the local electric and water company to put in a central heating plant to supply the business and many portions of the residence sections of the city.

Milwaukee, Wis.—Changes in the heating, decorating and lighting systems of

the Pabst Theatre are to be made during the summer. H. W. Buemming is the architect.

Jackson, Mich.—A reduction in coal bills from $30,000 a year to $17,510.68 is reported at the State prison at Jackson, as a result of the installation of the new power plant and heating system. The buildings are heated with exhaust steam.

Tacoma, Wash.—Tacoma's city jail in the city hall was reported to be badly in need of proper ventilation as the result of an investigation by a committee of ministers from the Methodist Ministers' Union.

Cleveland, O.—Claiming that the atmosphere in the machine booths of moving-picture theatres is conducive to disease of the lungs, members of a local moving-machine operators' union have appeared before the board of health with recommendations for an ordinance that will provide for the ventilation of these booths, as well as of the theatres themselves. It was stated that during the last two years four operators in Cleveland have died from tuberculosis.

Andrews Heating Co., Chicago, is filling an order for a complete hot-water heating plant to be shipped to Kwangau, Corea, to be used in heating a hospital building at that point

Quincy (Ill.) Gas, Electric & Heating Co. has formally accepted the thirty-year franchise recently granted to it by the city council of Quincy.

Portsmouth, O.—Claiming that they did not have sufficient ventilation in the department where they were working, seven apprentices and one machinist walked out of the Heer Engine Co., refusing to continue work without better ventilation.

Milwaukee, Wis.—Health Commissioner Kraft has served an order on Supt. Klug of public buildings, directing that the ventilation on the district court be improved. Two suction fans have been ordered placed in the court room and the transoms changed.

Denver, Colo. The consolidation is announced of the Lacombe Electric Co., capital $700,000; Denver Steam Heating Co., $300,000; and the Denver Gas & Electric Co., with $6,056,050 outstanding bonds. The merger is the result of a scheme outlined by Henry L. Dougherty, who controls the companies in question. Patrons of the Denver steam heating system, it is stated will be greatly benefited by the consolidation. A new plant will be built to cost over $750,000 and [illegible]

Boiler and Radiator Manufacturers elected the following new officers at their recent meeting at the Hotel Astor, New York: President, P. M. Beecher; secretary, William Ritchie.

Washington, D. C.—The appointment is announced of Nelson S. Thompson as chief mechanical and electrical engineer in the office of the supervising architect, Treasury Department. Mr. Thompson succeeds J. E. Powell, who retires on account of ill health. Mr. Thompson is well known to heating and ventilating engineers and has presented a number of papers before the American Society of Heating and Ventilating Engineers, of which he is a member.

Institute of Operating Engineers held a meeting June 17 at its headquarters in the Engineering Societies Building, New York, for the purpose of incorporating. Hubert E. Collins opened the meeting. J. C. Jurgensen was elected to the chair and H. E. Collins was made secretary. The attendance was 85, of whom 58 were members. The meeting was addressed by a number of speakers, following which the roll call was made, and the executive committee signed the incorporation papers, which makes the Institute of Operating Engineers a legal and duly incorporated institute of learning, empowered to issue certificates and diplomas for the various grades. The institute starts with a charter membership of 326. The first annual meeting will be held in New York, Sept. 1, 1911, for the election of officers and transaction of business.

National Association of Master Plumbers, at its twenty-ninth annual convention, held in Galveston, Tex., June 13-16, 1911, elected the following officers for the ensuing year: President, A. C. Eynon, Canton, O.; vice-president, Frank J. Fee, New York; secretary (nominated by the new president), Louis E. Deuble, Canton, O.; treasurer, William McCoach, Philadelphia. The report of the secretary showed a gain in membership of 100, while the treasurer's report showed a balance on hand of $10,700, and the national association was declared to be in healthier shape than ever before. It was voted to hold the next convention in Salt Lake City.

Manufacturers' Notes

Federal-Huber Co., Chicago and New York, announces the withdrawal from the company of A. D. Sanders and A. D. Sanders, Jr., general manager and treasurer, respectively. Their interests in the Federal-Huber Co. have been purchased by Donald A. Raymond, the vice-president. In addition to his other duties, Mr. Raymond assumes the office of treasurer. Mr. Sanders has served as president of the Central Supply Association and of the National Association of Brass Manufacturers, and also as a member of the National Committee of the Confederated Supply Association. The future plans of the Messrs. Sanders have not been announced.

United Electric Co., Canton, O., manufacturers of the Tuec air cleaning devices, has appointed Frederick A. Wilson in charge of its New York branch at 129 Worth street.

Pullman Automatic Ventilator Co., York, Pa., has appointed C. C. Frick in charge of its plant at York. Mr. Frick recently resigned as vice-president of the Security Title and Trust Co., of York. Judge Wanner has handed down an opinion in the equity proceedings of the York Trust Co. against the corporation, dissolving the injunction issued against the concern, June 6, 1910, and commanding W. W. Birnstock, the receiver, to deliver to the defendant all of its property. It is the purpose of the officers of the company to rehabilitate the business.

Abram Cox Stove Co., Philadelphia, Pa., announces the resignation of Charles S. Prizer as first vice-president, effective June 1. Mr. Prizer is succeeded by R. H. Thomas.

United States Radiator Corporation, Detroit, Mich., has leased the ground floor and basement of the northeast corner of Fourteenth and Pine streets, in

St. Louis, Mo., for a term of years. The rooms will be occupied as headquarters and show rooms of the St. Louis branch.

News Firms and Business Changes

Murphy & Lewis, Land Title Building, Philadelphia, Pa., is a new firm composed of E. T. Murphy and A. T. Lewis, which will act as sales managers for the Buffalo Forge Co., Buffalo Steam Pump Co. and the Carrier Air Conditioning Co.

E. F. Singer & Co., 333 Hudson street, New York, has entered the heating and ventilating contracting field.

Bayley Heating Supply Co., Milwaukee, Wis., is the changed name of the Bayley Heating Co.

Aetna Heating and Ventilating Co., formerly of New Britain, Conn., and New York, has located at 422 West 38th street, New York, where in future all of its business will be conducted. The building has been refittted, and considerable new machinery installed in connection with the company's workshop.

York Engineering Co., York, Pa., has been licensed to do business in Virginia, a written power of attorney being filed with the commission appointing W. H. Campbell, of Richmond, statutory agent. The maximum capital authorized by the charter is $50,000, and the objects and purposes the installing of heating and ventilating systems.

Grimshaw & Sturges, 41 Christopher street, New York, is a new firm which will engage in contracting work in connection with the installation of heating, ventilating and power plants. One of the principals is D. E. Grimshaw.

Business Chances

Durant, Okla.—At a special election held in Durant the citizens voted to issue $10,000 bonds to install steam heating systems in four ward school buildings.

Watertown, Minn.—At a special school meeting it was voted to issue bonds to the amount of $3,500 to install a heating plant in the new high school building.

Peoria, Ill.—The Peoria State Hospital has obtained an appropriation for the current year of $943,536.68. Included in the items is $50,000 to begin the work of converting the present hot water heating system into a steam heating system; also $30,000 to begin work of constructing an independent water works for the asylum.

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following named work:

Until July 21, 1911, for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures of the United States post office at Alpena, Mich.

Until July 25, 1911, for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures of the United States post office at Schenectady, N. Y.

New Corporations

George J. Gilsdorf Co., Toledo, O., capital $10,000, to conduct a heating and plumbing contracting business. Incorporators: George J. Gilsdorf, William Lower, W. S. Bauserman, Carl J. Lindecker and C. C. Whitmore.

John Davis Plumbing Co., Elizabeth, N. J., capital $10,000, to engage in heating and plumbing contracting. Incorporators: John Davis, Lucy M. Davis and Harold L. Crane.

Taylor-Flagg Co., Meriden, Conn., capital $35,000, to engage in heating and plumbing business.

Mahony Boiler & Radiator Co., Green Island, N. Y., capital $75,000, to manufacture radiators, boilers and special heaters. The company has recently purchased a plant at Green Island.

General Engineering Co., Fargo, N. D., capital $50,000, to engage in heating, plumbing and electrical work. President, James Kennedy; vice-president, Alex. Stern; secretary and treasurer, W. F. Fortune.

R. H. Lovering Co., Boston, to conduct a heating contracting business. President, R. B. Lovering; treasurer, R. H. Lovering. The foregoing, together with L. V. Walsh, are the incorporators.

Howard-Haley Co., Roanoke, Va., capital $10,000. President, J. E. Howell; vice-president J. M. Haley; secretary and treasurer, G. W. Howell.

Automatic Ventilating Co., Los Angeles, Cal., capital $75,000. Incorporators: L. O. Matthews, J. K. Pennington, M. A. Pennington, N. L. Harden and O. R. Harden.

Boston Heating Co., Buffalo, N. Y., capital $25,000, to engage in heating contracting business. Incorporators: Jason N. Whitcomb, Stuart A. Cummings and George M. Youker, all of Buffalo.

Globe Heating and Engineering Co., St. Louis, Mo. Incorporators: Frank A. Wheeler, Henry A. Dows and T. Warren Jones.

Union Blower & Engineering Co., capital $50,000. Incorporators: R. V. Whiting, F. H. Bryant and L. F. Halloran.

W. E. Keene Co., Cleveland, O., capital $10,000, to manufacture heating and ventilating specialties. Incorporators: C. B. Vinton, W. D. Elliott, William E. Keene, Elizabeth Hatch and Maude E. Keene.

D. & T. Manufacturing Co., 1915 Hamilton avenue, St. Louis, Mo., capital $30,000, to manufacture and market an automatic hot water regulator and circulator. President and manager, J. M. Doherty; secretary and treasurer, H. C. Tatler.

Contracts Awarded

J. C. St. John Plumbing & Heating Co., Colorado Springs, Colo., heating and plumbing new Chaves County court house in New Mexico for $12,000.

Huffman-Conklin Co., Columbus, O., was the low bidder for the heating and plumbing work for the general hospital buildings in Cincinnati.

H. Kelly & Co., Minneapolis, Minn., power plant and ventilating and heating systems for the Hospital for Inebriates at Willmar. The work will amount to $28,200.

Columbus Heating & Ventilating Co., Columbus, O., hot air heating system in the Washington School building at Wheeling, W. Va., for $7,490.

Thomson & Horner, Winnipeg, Man., heating and ventilating Strathcona school and addition for $16,300. The work will include air washer and vacuum cleaning system; also automatic temperature control system.

Abrahamson & DeGear, San Francisco, Cal., heating and ventilating John Swett grammar school in San Francisco for $8,580.

Garden City Fan Co., Niles, Mich., was finally awarded the contract for the ventilating equipment for the new high school building at that place. Evans & Co., who are the contractors, had let the contract to the B. F. Sturtevant Co., but a storm of protest arose over the fact that the Garden City Fan Co., which is a local industry, was not permitted to do the work. Citizens took up the matter and the Sturtevant Co. finally agreed to relinquish the contract for about $1,200. The money was raised by subscription.

Clift Wise, Springfield, O., new hot blast heating plant at the Champion division of the International Harvester Co.

Brunka Bros., Marion, Ind., heating the Marion public library for $1,972. Hot water for the heating system will be supplied from the mains of the Marion Light & Heating Co. The building will be equipped with 53,000 sq. ft. of radiation.

J. Wahlman & Son, Ishpeming, Mich., heating plant for Princeton Mine No. 2, of the Cleveland Cliffs Iron Co. The building will be a single story structure of concrete and brick, 32 ft. long and 26 ft. wide.

McMahon Heating & Plumbing Co., Kansas City, Mo., heating and ventilating the building for contagious diseases of the general hospital at Kansas City, for $7,000; the plumbing contract went to Graham & Co., at their bid of $5,300.

Otis Engineering Co., Oswego, N. Y., heating and plumbing Hotel Pontiac for $20,133.

W. D. Mohn Co., Reading, Pa., heating system for Hope Rescue Mission in Reading.

Donnelly & White, Austin, Tex., steam heating Federal building at Dennison, Tex.

Trade Literature

This Is the Only Theatre in St. Louis that Is Fighting the White Plague is the title of a folder describing the cooling and air-purifying effects obtained in the Princess Theatre, St. Louis, which is equipped with the Kinealy system of air purifying and cooling, manufactured and installed by the Kauffman Heating & Engineering Co., of St. Louis. This theatre is supplied with 60,000 cu. ft. of air per minute, or 40 cu. ft. for each occupant, and the air is cooled as much as 20° F. in summer. The company states that this is one of over 300 plants of this type which it has designed and installed.

How New York's Municipal Buildings Are Heated is a folder issued by the H. W. Johns-Manville Co., New York, showing on the cover a group of municipal buildings in City Hall Park, New York, heated from one central plant through J-M sectional conduit. The central plant is located in the Hall of Records and dotted lines indicate the course of the conduit. Other views show details of construction; also a cross section of J-M sectional conduit through supporting tee. A striking series of pictures illustrates typical instances of unsatisfactory installations of other types of conduits.

Mueller Reducing and Regulating Valves is a new catalogue embracing the line of reducing and regulating valves made by the H. Mueller Mfg. Co., Decatur, Ill. The company states that it has gone extensively into this business and is making regulators for all kinds of service, including water, steam, air, gas, oil and ammonia. The company is also maintaining a corps of experts on the question of regulating different pressures and is in a position to answer any question or suggest a remedv where intricate problems of pressure exist. The catalogue is well illustrated and the desired information is given in condensed form. Pages 20. Size 6¼ in. x 10 in.

Central Station Heating, a handsomely gotten-up publication, issued by the American District Steam Co., Lockport, is a striking testimonial to the growth and success of the central station heating industry. The publication deals in a general way with central station heating and is illustrated throughout with views of private residences, business blocks, public buildings, etc., located in all parts of the United States and Canada which are now being heated by live and exhaust steam from central stations installed by the American District Steam Co. There are also illustrations of the company's methods of construction and other points of mechanical interest. The book is well worthy of a place in every engineer's library. Pp. 50. Size 8 x 10¾ in.

Vacuum Cleaning of Schoolhouses, by Thomas D. Perry, is a reprint, in pamphlet form, of a series of articles that appeared in the *American School Board Journal,* of Milwaukee, Wis. The articles review the methods employed in vacuum cleaning, both with portable and stationary outfits, and include the results of a number of tests with different types of apparatus. One of the articles gives outline specifications for vacuum cleaning equipment. Pp. 44. Size 4½ x 6¼ in.

Kauffman Quality—Kinealy Air Purifying, Cooling and Humidifying System is the title of a well-designed and exhaustive catalogue lately published by the Kauffman Heating & Engineering Co., St. Louis, Mo. The catalogue is intended for the use of architects, engineers, contractors and the general public who are interested in the subject of air purifying and air conditioning. The company's engineering staff includes Prof. J. H. Kinealy, the inventor of the system and apparatus. Full details are given regarding the high grade of materials used in the Kinealy air purifier, together with detailed directions for its installation and operation. A special section is devoted to data for the Kinealy air washer, Types A and B, while a number of pages are devoted to engineering data in connec-

tion with humidity work. Numerous illustrations of the apparatus serve to bring out clearly the various points mentioned in the descriptive matter. Views of buildings equipped wtih the Kinealy apparatus, in several cases accompanied by striking testimonials, are a notable indication of the efficiency of the apparatus, as indicated by its wide use. Pp. 55. Size 8 x 8½ in.

Royal Smokeless Boilers, made by the Hart & Crouse Co., Utica, N. Y., is the title of an interesting publication devoted to the type of heater, which is equipped with a down-draft grate. The point is made that this boiler will burn soft coal of any grade without showing smoke. The boiler is of water tube construction, having two fires. Raw fuel is thrown on the upper grate, through which water circulates. The fire burns downward, so that all smoke and gases must pass downward through the body of fire, with the result that opportunity is given them to become fully ignited and thus perfect combustion secured. Many buildings are shown which have been equipped with this type of boiler. Pp. 48. Size 8 x 8 in.

THE HEATING AND VENTILATING MAGAZINE

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Central Station Heating

5.—PIPE LINE LOSSES FROM FRICTION

By Byron T. Gifford

(Previous articles in this series: "Pipe Line Losses from Radiation," April, 1911; "Rates," May, 1911; "'Ready to Serve' or 'Maximum Demand' Rate," June, 1911; "Operation," July, 1911.)

Loss Due to Friction

Steam Mains.—Many different formulas and tables are in use for figuring the loss due to friction. The velocity, quantity of steam flowing, as well as the pressure, affect the friction on the sides of the pipe and, if the steam flows in the opposite direction to the condensation, we add another factor which materially affects the friction loss, due to the skin friction of the water and the steam, as well as the partial choking of the pipe area, on account of the depth of water necessary to give the condensation sufficient head to drain back.

As a rough method of estimating friction loss in heat units use may be made of the pipe capacity curves here given.

Multiply the pressure drop given on the curves (Charts Nos. 1, 2 and 3) by the factor or constant 0.2. This will give the number of heat units lost per pound of steam. This product multiplied by the number of pounds of steam per hour will give the total heat units lost per hour in low pressure steam mains.

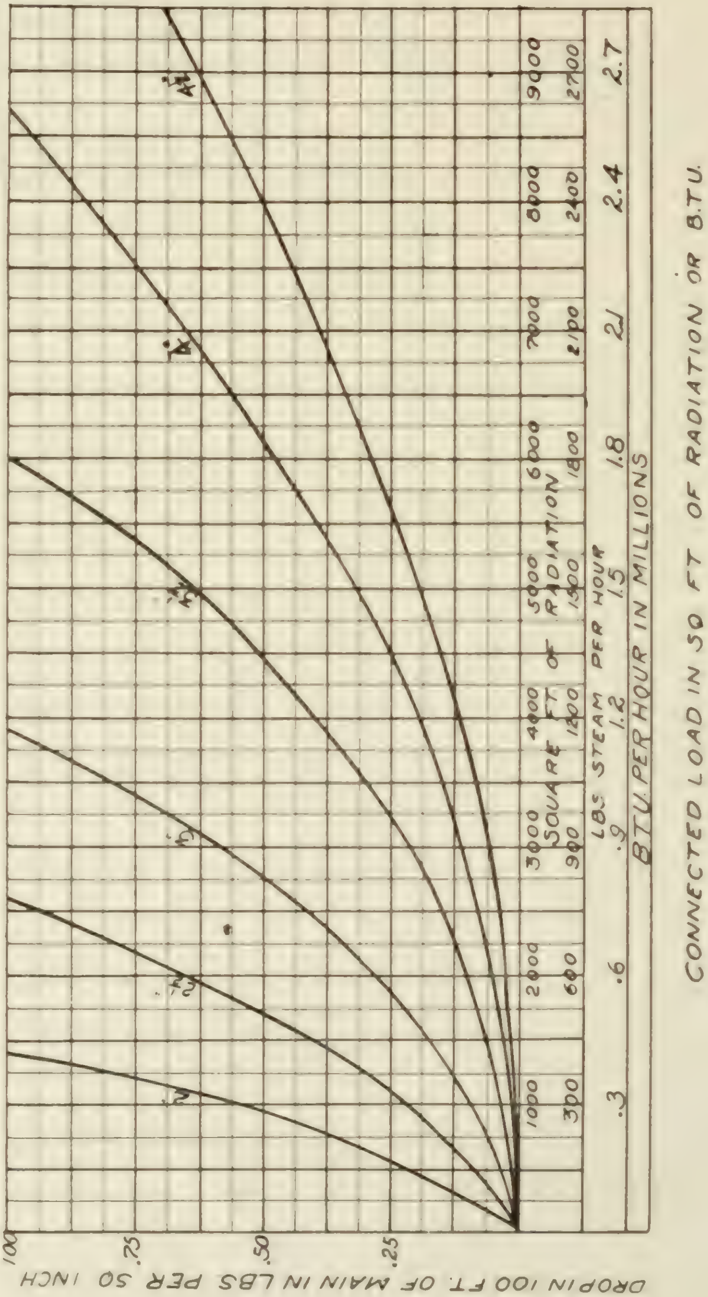
By referring to Pipe Capacity Chart No. 1:

1000 lbs. steam per hour in a 4-in. pipe 1000 ft. long.

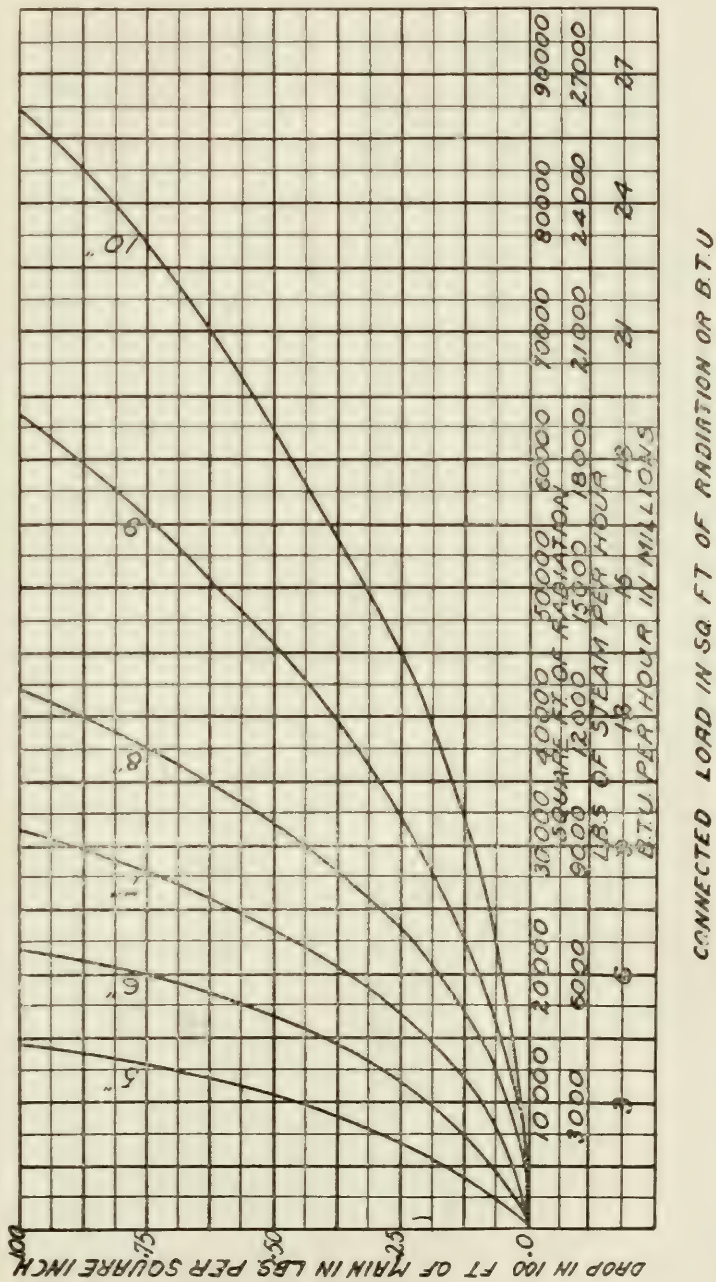
Loss = $1.2 \times 0.2 \times 1000 = 240$ B.T.U.

Same in a 3-in. pipe = $7.3 \times 0.2 \times 1000 = 1460$ B.T.U.

Same in a $3\frac{1}{2}$-in. pipe = $2.5 \times 0.2 \times 1000 = 500$ B.T.U.



2"
2½"
3"
3½"
4"
4½"
1000
2000
3000
4000
5000
6000
7000
8000
9000
SQUARE FT. OF RADIATION
300
600
900
1200
1500
1800
2100
2400
2700
LBS STEAM PER HOUR
.3
.6
.9
1.2
1.5
1.8
2.1
2.4
2.7
BTU. PER HOUR IN MILLIONS
CONNECTED LOAD IN SQ FT OF RADIATION OR B.T.U.
1.00
.75
.50
.25
DROP IN 100 FT. OF MAIN IN LBS PER SQ INCH



PRESSURE DROP IN STEAM MAINS, 5-IN. TO 10-IN., BOTH INCLUSIVE

Based on 0.33 lbs. Steam per Square Foot of Radiation per Hour. Also 1 lb. of Steam = 1000 B. T. U. Radiation Loss = 0.05 lbs. of Steam per Square Foot of Underground Surface.

Water Mains.—We have about the same conditions affecting the friction in water pipe lines that we have in steam pipes, the velocity, the quantity and the pressure. The natural laws of gravity also affect the flow.

To estimate the loss in B.T.U. in the friction of water pipes, refer to the pipe curves for water and use the following formula:

Example:—15,000 sq. ft. radiation, 5-in. pipe 1000 ft. long. From curve, friction drop is 0.52 lbs.

Loss in B.T.U. = 0.046 × F × R × L.
0.046 = a constant.
F = friction drop in lbs. per 100 ft.
R = radiation shown by table.
L = length in 100 ft.

In the case cited,

B.T.U. loss by friction = 0.046 × 0.52 × 15,000 × 10 = 3588 B.T.U. per hour.

The value of this constant 0.046 takes into consideration using the exhaust steam from the pumps in the heating system and also the usual circulating pump efficiency, which, in reciprocating pumps, is very low.

Combining the Losses from Radiation and Friction to Find the Most Economical-Sized Pipe Line.

Steam.—Given 1000 lbs. per hour to carry 1000 ft.

From our pipe curve for steam (Chart No. 1) we see that a 3-in., 3½-in., 4-in. and 4½-in. pipe will do this nicely but we must determine the most economical one.

Loss by friction according to formula:

3 -in. line = 1460 B.T.U.
3½-in. line = 500 B.T.U.
4 -in. line = 250 B.T.U.
4½-in. line = 130 B.T.U.

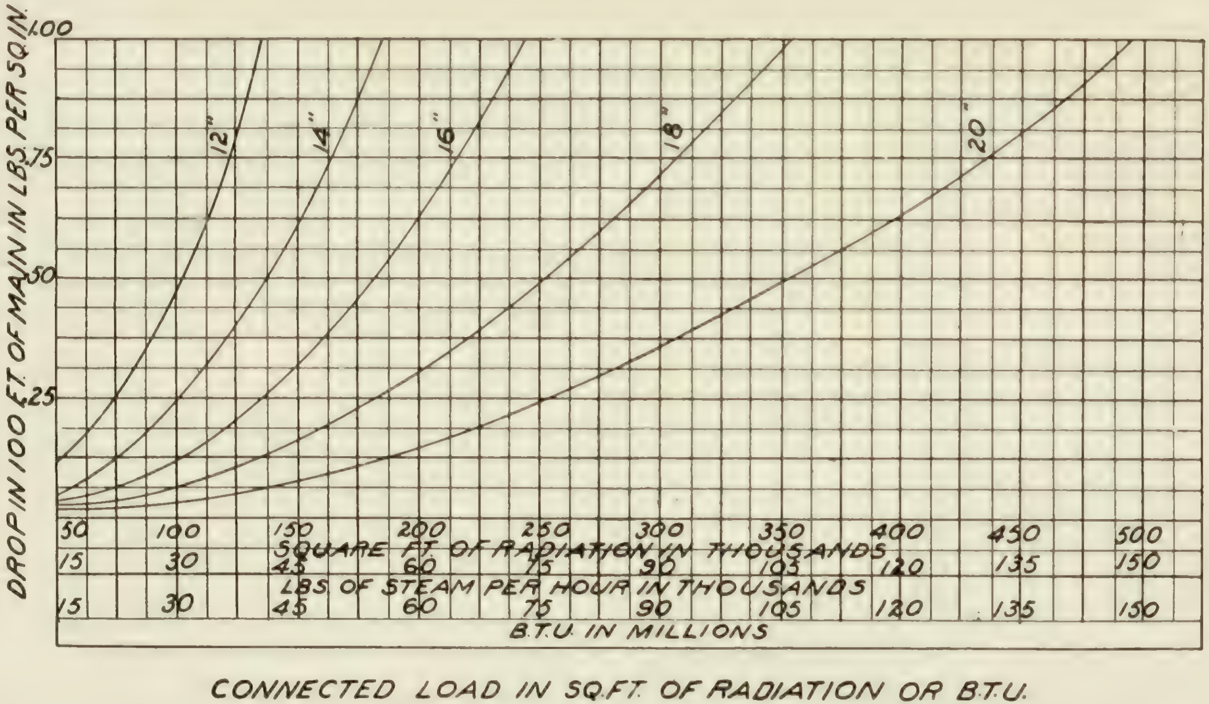
Radiation loss according to formula:

Value of C = 0.05
Assuming 1 lb. of steam = 1000 B.T.U.
3 -in. line = 45,800 B.T.U.
3½-in. line = 52,350 B.T.U.
4 -in. line = 58,900 B.T.U.
4½-in. line = 65,450 B.T.U.

Total loss:

3 -in. line = 47,260 B.T.U.
3½-in. line = 52,850 B.T.U.
4 -in. line = 59,150 B.T.U.
4½-in. line = 65,580 B.T.U.

This shows conclusively that the 3-in. line is the most economical to run, provided it does not affect our station



PRESSURE DROP IN STEAM MAINS, 12-IN. TO 20-IN., BOTH INCLUSIVE.

Based on 0.33 lb. Steam per Square Foot of Radiation per Hour. Also 1 lb. of Steam = 1000 B. T. U. Radiation Loss = 0.05 lbs. of Steam per Square Foot of Underground Surface.

conditions by causing excessive back pressure. From our pipe curve we find it will cause a drop of 7.3 lbs., which, with 1 lb. at the end of the line, means 8.3 lbs. at the station. If this does not affect our engines a 3-in. line would be the one to run, but, if we must keep our back-pressure below 5 lbs., we would be obliged to run a 3½-in. line.

Water.—Combining the friction loss and radiation loss in water pipe lines, we will assume a case.

Given 15,000 sq. ft. of radiation to heat 1000 ft. distant.

From our pipe capacity tables (Chart No. 4) we find that a 4-in., 4½-in., 5-in. or 6-in. pipe will handle this work. Asssume a pipe line loss, owing to class of insulation used, to be 30 B.T.U. per square foot of pipe surface per hour.

Radiation loss = from formula (H = sq. ft. × C).
4 -in. line = (1.178 × 30) × 1000 = 35,340 B.T.U.
4½-in. line = (1.309 × 30) × 1000 = 39,270 B.T.U.
5 -in. line = (1.456 × 30) × 1000 = 43,680 B.T.U.
6 -in. line = (1.734 × 30) × 1000 = 52,020 B.T.U.

Friction loss = from formula (L = 0.046 x F × R × L).
4 -in. line = 0.046 × 1.75 × 15,000 × 10 = 11,775 B.T.U.
4½-in. line = 0.046 × 1.1 × 15,000 × 10 = 7,590 B.T.U.
5 -in. line = 0.046 × 0.52 × 15,000 × 10 = 3,588 B.T.U.
6 -in. line = 0.046 × 0.25 × 15,000 × 10 = 1,725 B.T.U.

Combined radiation and friction losses.
4 -in. line = 47,115 B.T.U.
4½-in. line = 46,860 B.T.U.
5 -in. line = 47,268 B.T.U.
6 -in. line = 53,745 B.T.U.

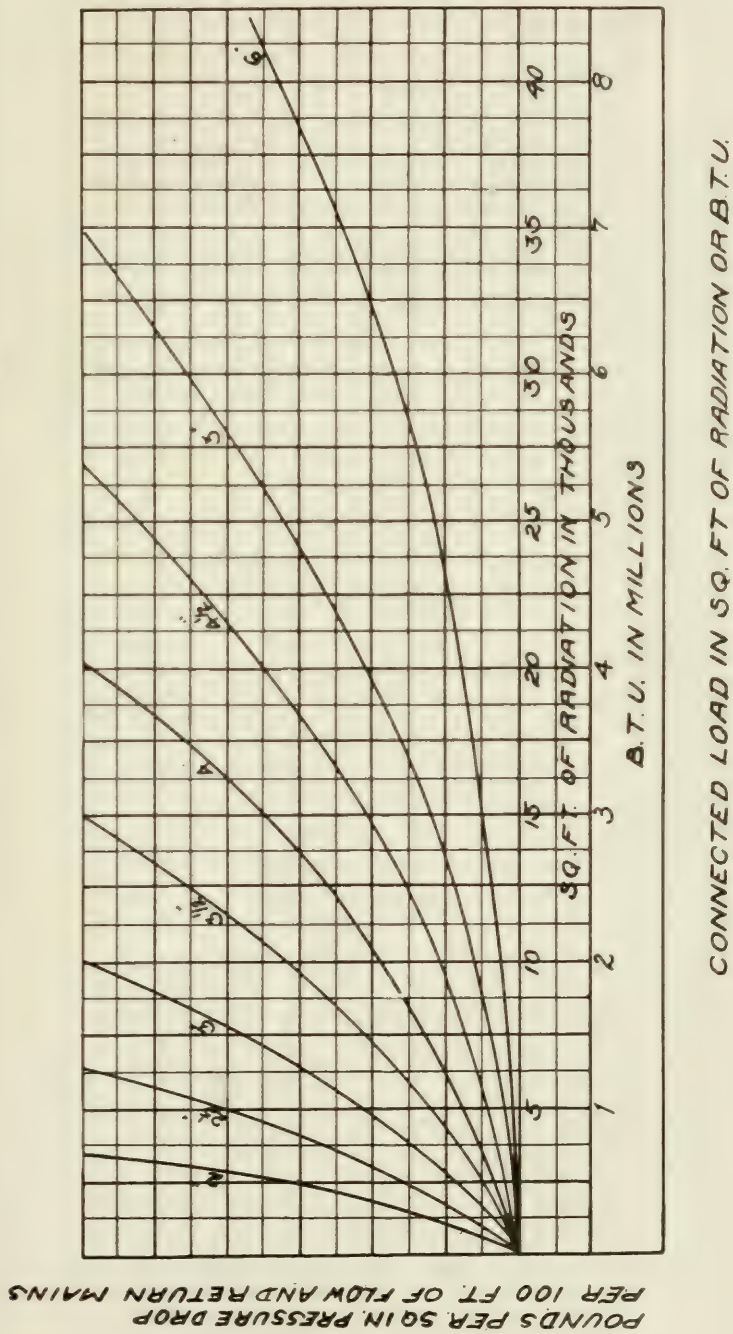
These figures show us that the 4½-in. line is the most economical line to install, but how our line pressures will be affected is important and must be taken into consideration.

The 4-in. line will give us a pressure drop in our differential pressure of 17.5 lbs.

The 4½-in. line will give us a drop of 10 lbs.
The 5 -in. line will give us a drop of 5.2 lbs.
The 6 -in. line will give us a drop of 2.5 lbs.

Therefore, if this line is to be connected at a point of large differential, as at a point near the station, we can afford to run the 4½-in. pipe, but, if we are to connect it at a point of low differential, as at the end of the system, the 5-in. would be the better size to install and it might be economy to install the 6-in. line.

From the above calculations on combined losses of steam and water a few conclusions can be deduced:



PRESSURE DROP IN HOT WATER MAINS, 2 IN. TO 6 IN. BOTH INCLUSIVE

Based on 1 Square Foot of Radiation Emitting 200 B.T.U. per Hour

First: In steam pipe lines the radiation loss is much more important than the friction loss.

Second: In water pipe lines the friction loss is decidedly more than in steam pipe lines, but still it is not as large as the radiation loss.

The heat we lose from friction is not lost in the pipe line, with a small exception, due to the fact that it tends to increase the temperature of the line and its contents and thus increase the radiation loss. Where we lose this heat is at the station, due to the increased pressure that is necessary to properly circulate the heating medium, whether it be steam or water. This is proven by the fact that if we circulate water fast enough in a small system we can eventually raise the temperature of the water in the system a considerable amount. In this case we obtain the heat from the circulating pump and transmit it to the water through the friction in the piping.

Another general conclusion we can deduct is that the less our friction loss, the less our pipe line loss in a given size line, for the radiation loss remains constant.

As can be readily comprehended, in every pipe line system we have a very nice problem to figure on and one that requires study and thought.

Of the two losses, that from friction and that from radiation, the radiation loss is much the greater and from the above formulas we can tell how much can be lost or saved in the pipe line insulation and construction.

Knowing the cost of 1000 lbs. of steam in a steam plant or the cost per 1,000,000 B.T.U. in a water plant, it is easy to figure how much can be spent on insulation to reduce the factor "C."

For example: Assume our pipe line loss to be 0.05 lbs. per square foot per hour.

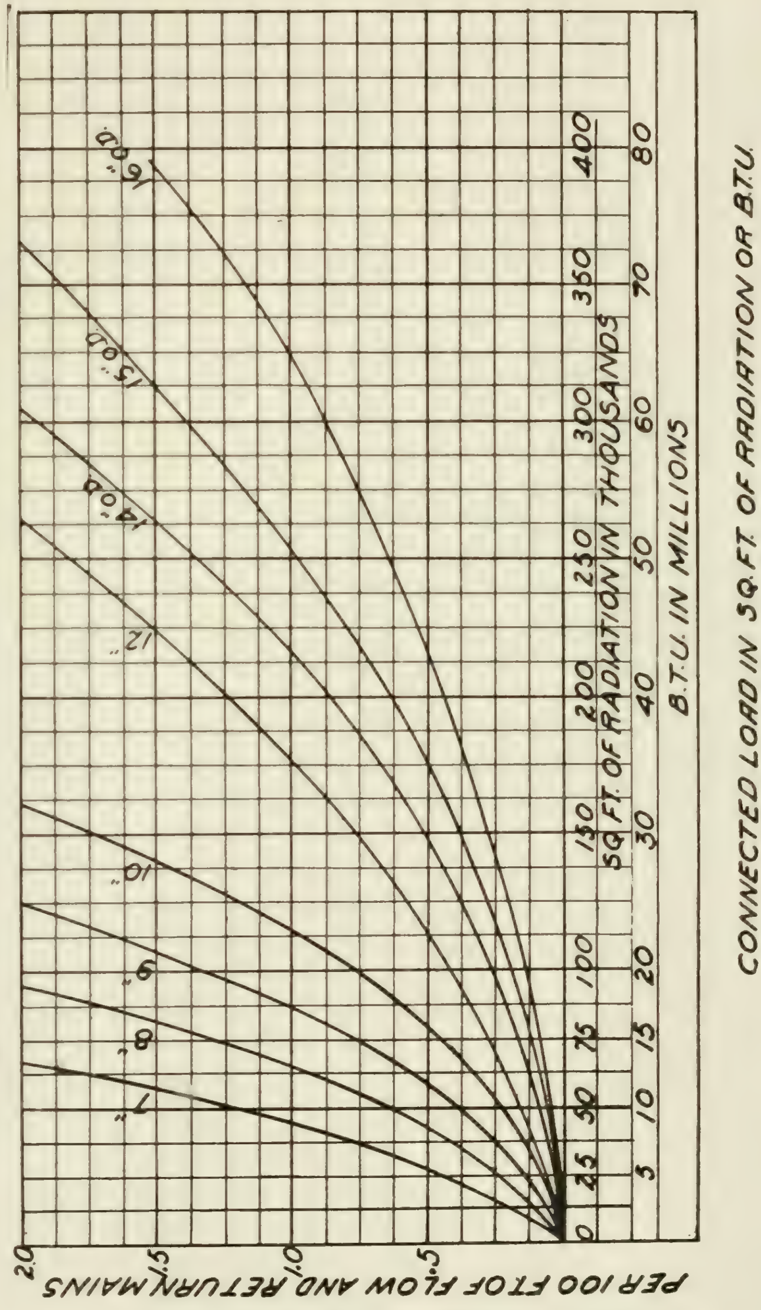
Assume 1000 lbs. steam costs to generate 25c.

Steam per square foot per hour for 5200 hrs. = 5200 × 0.05 = 260 lbs. steam per season = 6.5c.

With a pipe line loss of 0.04 lbs. steam per square foot per hour, for 5200 hours we would have a charge 5.2c. or a saving of 1.3c. per season per square foot of pipe line surface for every 1/100 lbs. of steam saved.

Assume a pipe line with 60,000 sq. ft. of surface; 1/100 lbs. of steam saved by increasing our insulation would save us $780.00 per year or 10% on $7,800.00 or 10% on 13c. per square foot of surface, which would show a saving as follows on the various sized lines:

The following is a table showing the amount of money it would be profitable to spend each year to in-



PRESSURE DROP IN HOT WATER MAINS, 7 IN. TO 16 IN., BOTH INCLUSIVE.

Based on 1 Square Foot of Radiation Emitting 200 B. T. U. per Hour.

crease the insulating qualities of the pipe line so as to save 1/100 lb. of steam per hour per square foot.

Diameter of Line, in Inches.	Cents per Lineal Foot.
3	11.9
4	15.3
5	18.9
6	22.5
8	29.25
10	36.5
12	42.25
14 O.D.	47.64
16 O.D.	54.44
20 O.D.	61.57

From the above table we can figure how much more one insulation is worth than another and also how much we can afford to spend to increase the insulating qualities of our pipe line system.

For example: A 16-in. steam line, covered with wood boxing, badly rotted ($C = 0.10$) is costing us about three times too much to operate and we could afford to spend to bring our line loss to 0.04 (6×54.44c.) = \$3.27 per foot per year. If we repair this insulation or replace it with new so that it will last 10 years, we could afford to spend \$32.70 per foot to do it. This shows how valuable and essential, efficient and durable insulation is.

As pipe line losses from radiation are by far the greatest loss in central station heating, it is at this place where we can afford to look for leaks and can afford to fix them. The operating manager who is overlooking this point is blind to his own interests.

Summer Meeting of British Heating Engineers

An attendance of 63 members and guests marked the mid-summer meeting of the Institution of Heating and Ventilating Engineers, at Chester, England, July 3-5. The professional sessions were held at the Grosvenor Hotel, with the president, O. M. Row, presiding. Forty-three new members and associates were elected at the meeting, in addition to a number of transfers from associate to full membership.

The papers read were as follows:

"Some Doubtful Points in Gravity Hot Water Heating," by E. R. Dolby, of London.

"Characteristics of the Propeller Fan," by Oswald Scott, of Birmingham.

"Saving in Electricity by Applying the Reck 'Mixing' System to Hot Water Heating Apparatus Worked by Electrically-driven Pumps," by Capt. A. B. Reck, of Copenhagen.

The next meeting of the institute will be held in London, October 17, 1911, at the Institution of Mechanical Engineers.

One of the most interesting features of the entertainment programme, which included a variety of excursions and other diversions, was the annual banquet at which a toast was proposed by P. M. Krebs to The American Society of Heating and Ventilating Engineers. The toast, which was enthusiastically received, was responded to by Walter Yates and Charles R. Honiball, members of the American Society.

The usual group photograph was taken on the lawn of the Northwestern Hotel at Llandudno, whither the party had proceeded as the guests of President and Mrs. O. M. Row.

Superheated Steam in Heating Work

By W. E. Dowd, Jr.

Heating engineers interested in the uses of superheated steam have been recently favored with an elucidation of the subject from the point of view of present-day practice, as contained in a paper presented at the recent annual meeting of the National District Heating Association in Pittsburg. The animated discussion following the reading of the paper showed not only the keen interest in the subject felt by engineers generally, but also by the growing use of superheated steam in heating work. The principal portion of Mr. Dowd's paper are presented herewith:

The steam superheater is one of the most interesting developments that has resulted from modern power plant requirements. It is interesting because it is the only auxiliary apparatus used in the boiler room which decidedly affects the quality of the steam generated. In the last fifty years, many improvements have been made in boilers and their appurtenances. The water tube boiler replaces the fire tube and not only occupies less floor space, but allows greater steam pressures to be carried. The mechanical stoker, with forced draft, permits the burning of more coal and has improved the combustion. The economizer, which is really a primarily boiler, has increased the economy and capacity of steam generating by the utilization of the heat in the waste gases.

While these advantages have resultin increased capacities and greater economies, none of them has had any effect on the plant outside of the boiler room. The superheater, however, not only affects the economy and capacity of the steam generator proper, but offers decided advantages in the transmission and consumption of steam for all purposes.

TWO CLASSES OF SUPERHEATERS

Before taking up the advantages of superheated steam we will investigate the methods adopted to generate it. The many types of successful superheaters may be divided into two general classes. First the attached type, in which the superheating tubes are installed inside the boiler setting; and second the separately fired type in which the superheating surface is operated by an independent furnace.

Both of these types have their offices and a combination of them is often found beneficial. Broadly speaking, the attached type of superheater should be used where a moderate degree of superheat only is desired, and where the duty is comparatively constant. The superheater installed in the boiler setting has the advantage of requiring no extra floor space, nor attention beyond that given the boiler proper, and is automatic in its operation in that the desired temperature will be obtained under practically all operating conditions.

The separately fired superheater may be used where high temperatures are desired, or where requirements demand only the superheating of a portion of the steam, or where superheated steam is only desired at certain periods of the plant's operation. Having its individual setting and furnace this superheater may be operated independently of the boilers, and its capacity is very elastic. The combination of these two types of superheaters would naturally result from a combination of the requirements which each best fulfills and we find many plants in which the boilers are all equipped with attached superheaters and certain departments also employ a separately fired superheater.

WHERE SUPERHEATED STEAM IS USED TO ADVANTAGE

Having established the two general methods of obtaining superheated steam, we may now investigate the advantages of its use. Superheat may be defined as heat added to steam without increasing its pressure, or heat imparting to the steam a higher temperature than that shown in the steam tables. This additional heat is of advantage in two distinct fields.

The first, where steam is used expansively in power plant work where the prevention of condensation effects an increased economy; and second, where steam is used for heating in process work, under which conditions the increased calorific value is of benefit.

But, in either case, the prevention of condensation in transmission from the stop valve in the boiler room to the point of consumption is an important item. Even in the best plants, with short mains and the best forms of insulation, this loss is noticeable, but where necessity demands long transmission lines, the use of superheat cannot be too strongly recommended. By its adoption smaller pipes may be used without increasing the loss in pressure; operation may be resumed in much shorter time after a period of inactivity; the expense of separators, traps and return drains may be eliminated; and the advantage of dry steam at the point of consumption may be obtained.

Data has been accumulated which gives us the loss in temperature for the transmission of superheated steam through various sizes and lengths of piping, and specialists in this department of thermo-dynamics can estimate the amount of superheat necessary for transmission under any given condition.

SUPERHEATED STEAM PREVENTS CONDENSATION IN ENGINES

In the engine, whether it be of the reciprocating or rotary type, the benefit of superheat is due to the prevention of condensation. Tests run on pumps and engines, horizontal or vertical, simple or compound, condensing or non-condensing, prove that this increased economy will range from 1% to 3% net steam saving for each 10° of superheat at the throttles; this means that 150° superheat at the throttle of a simple direct acting pump would reduce its steam consumption by 50%. In a high speed, jacketed, compound, condensing engine, or steam turbine, the saving would be 15% net steam, due to 150° superheat.

These two cases are the extremes in point of saving due to superheat. In the former, the condensation of the steam forms a large percentage of the loss and the increased economy is, therefore, very great; in the latter, condensation of steam has been largely eliminated through other sources and the saving due to superheat is, therefore, not so great.

Although authorities differed in the past as to the proper amount of superheat, the best engineering practice to-day favors the use of a total temperature of 500° F. at the throttles of the engine room equipment. This would represent a superheat of 175° at 100 lbs. pressure, and 125° at 200 lbs. Such a temperature, if held constant, would not be injurious to even the oldest types of valve mechanism, nor would it interfere with cylinder lubrication. This moderate temperature could also be used on all the auxiliaries of the plant and the piping thus simplified.

IN PROCESS WORK ADVANTAGE LIES IN INCREASED CALORIFIC VALUE

In the process or heating service, the advantage of superheat is due to its increased calorific value. There is hardly a field of heating by steam in which the advanced exponents have not found superheat to be beneficial. Superheated steam is now being used on kettles, dryers and stills whether they be equipped with exterior jackets, or interior coils or heated by direct admission of steam; an economy either in decreased cost of heating, or in increased capacity of the machine has been effected in every case, and it is under this heating service that the small separately fired superheater has met its greatest commercial success.

For heating, the use of superheated steam is either beneficial in permitting a high temperature to be obtained without carrying extremely high pressures, or its use husbands the valuable latent heat in the steam until it may be employed at the point of consumption; and we find the use of superheat under such conditions to affect a saving of from 25% increased capacity to 5% decreased steam consumption.

This service, however, covers such a wide field that specific conditions must be cited before an intelligent estimate of the benefits of superheat may be made, and the proper amount of superheat determined.

Temperatures as high as 1000° F. have been obtained without injury to the superheater, but this point should be considered the ultimate capacity for practical service. It must, however, be remembered that superheat should not be used for heating such products as would be injured by high temperatures.

TYPICAL CASE WHERE BOTH TYPES OF SUPERHEATERS ARE USED

Having outlined the two methods of obtaining superheat, and the two services under which it is of advantage, it is believed that the combination of these conditions will prove of particular interest. We will consider a power plant using either water or fire-tube boilers, the steam from which operates cross compound, non-condensing engines and the exhaust from which, in turn, is used for heating. We find under these conditions both types of superheaters may be of benefit for both services. The installation of the attached form of superheaters in the boilers to add 150° of superheat to the steam generated by them would prevent all condensation in the steam admitted to the throttles of the engines and a given horsepower would be obtained with a saving of from 15% to 18% of the steam. This steam saving, as has been stated above, results from the prevention of condensation both before and after the point of cut-off in the cylinder. The moisture in the exhaust from this engine, therefore, will be reduced by exactly the same amount. We therefore see that the calorific value of this exhaust is not reduced by the decreased consumption in the cylinder. This is a most important point and is often overlooked. However, when it is considered that nearly three-quarters of the heating value of steam is due to its latent heat, and that this latent heat has been lost in every pound of moisture condensed, the merit of the statement will be apparent.

If this exhaust steam is to be used at some distance from the engine, it would be advisable to pass it through a separately fired superheater, located near the engine outlet, of such capacity as to add 1° of superheat for each 10 ft. of the best type of transmission main. Thus, if a building were to be heated 500 ft. from the engine room, 50° should be added to insure dry steam at the point of consumption, if the main well covered and designed for a velocity of 5000 ft. per minute; if a slower speed than this obtains, a proportionately higher superheat should be added. If, instead of heating a building, the steam is to be used for process work in which a high temperature would be of advantage, an additional 150° or 200° could be well added to the temperature but this additional superheat is unnecessary for imparting temperatures under 100° F. The installation of these two superheaters would not only save an appreciable percentage of the initial steam, but would offer a much higher heating agent at the point of ultimate consumption.

COST OF SUPERHEATED STEAM

In contemplating the advantages of superheated steam, however, we must not forget the cost of obtaining it. Considering the specific heat of superheated steam to be 0.5, the addition of 150° to saturated steam at 150 lbs. pressure would theoretically require 7½% increase in total fuel consumption. This actual figure, however, is only reached where the temperature is added in a separately fired superheater. In this apparatus stack, radiation and ash pit losses are encountered and the efficiency of the unit will only be about 70%. The installation of the superheating surface in the boiler setting, however, is apt to improve the boiler efficiency, as the tubes, to some extent, absorb waste heat from the furnace gases, and we find that where superheaters are attached to uneconomical boilers the added temperature is acquired with no fuel cost, and, where more efficient

boilers are in use, the combination with superheating tubes will improve the evaporation by from 1% to 3%. In other words 7½% additional calorific value may be added to the steam by increasing the fuel consumption from nothing to 6½%. However, this increased calorific value, as has been noted above, will effect a steam saving of from 50% to 15% and thus we find the net fuel saving due to superheat of 150° in power plant operation to be from 8½% to 50%, depending on the type of boilers and prime movers operated, and it is conservative to state that the average benefit due to 150° superheat would be 15% net fuel saving.

This increased economy of the plant, however, should be considered in connection with the hours of annual operation at capacity. Irrespective of the type of machinery in use, the load factor under which the plant operates should dictate the advisability of installating superheaters. Although equipments have been purchased which paid for themselves in coal saving each year, such satisfactory results cannot generally be expected.

Superheaters should be favorably considered if their use would effect a net interest on investment of 10% above depreciation and maintenance charges. This earning capacity would be obtained in a plant of practically any size which operates at one-third of its capacity and burns coal costing $2 per ton, or over.

In considering the use of superheated steam in this article, only well designed and properly constructed superheaters have been considered; for although the best apparatus will give very satisfactory results, a bad or cheap superheater would prove worse than useless on account of the troubles it would cause. A large proportion of the earlier articles written on superheated steam was devoted to explaining the troubles reported from its use. To-day, however, superheat needs no such defense.

A thorough investigation of all the unsatisfactory installations proved them to suffer from the common fault of excessive temperatures. This was caused either by faulty design, or bad construction of the superheating surface. A momentarily high temperature is fully as injurious to engines or turbines as a constant application of great heat.

The best authorities now disapprove of operating a plant under normal conditions, at a higher temperature than 600° F., and the best superheaters have demonstrated their ability to deliver steam at the temperature for which they were designed without fluctuations. It is this advance in the study of the art that is responsible for the rapidly increasing popularity of the superheater and its resultant enormous list of installations which is now reported to aggregate nearly 2,000,000 H.P., in this country.

Some Doubtful Points in Gravity Hot Water Heating

Figuring a hot water gravity system according to the various methods recommended by such well-known authorities as Charles Hood (England), William J. Baldwin and Prof. R. C. Carpenter (United States) and H. Reitschel (Germany) the author of a paper read at a recent meeting of the Institution (British) of Heating and Ventilating Engineers, showed that there are wide differences between the results obtained by using these methods.

The author, Ernest R. Dolby, assumed, for instance, a water column 40 ft. high with the temperature of the flow 200° F. and the temperature of the return 160° F. The results for this particular case, he found, would give heads as follows: Hood, 6.838

in.; Baldwin, 6.708 in.; Carpenter, 3.6 in.; Reitschel, 6.71 in. All agree fairly closely in this instance, except Professor Carpenter, the head given by his method being only about 53% of the average value of the other three.

Proceeding, the author referred to a simple type of hot water heating system in which the water leaves the top of the boiler at a temperature of 200° F. and returns to the boiler at 160° F. It becomes merely necessary then to decide what is the height of the column of water in question.

This particular point, the author states, does not seem to be clear to many persons engaged in the heating business and he gives it as his opinion that the only satisfactory method is to take the centre of gravity of the boiler and the centre of gravity of the radiator and measure the vertical height between the two points. The question then is, what effective head is present in the system which will cause the circulation of the water?

Hood's theory, as given by the author, is that the proper method to adopt is to consider the two columns of water as at an initial temperature of 39° F., and then to discover by how much the length of each column would expand if heated to the temperature assumed above, and to deduct the height of one column from the other, and call this difference the head available to overcome all the frictional resistances encountered in the system.

The author observed that the sole reason for desiring to discover the effective head is so that by using certain tables or formulæ concerning the flow of water in pipes, it may be possible to decide what is, for this particular case, the most suitable size of pipe to adopt. He also calls attention to the fact that in ordinary hydraulic work all the tables used have been calculated from experiments made upon pipes in which water at a temperature of, say, 40° to 50° F. was flowing and that, in most cases, this temperature would be practically constant. It seems, therefore, that in considering a heating circulation, a temperature must be assumed which is the mean of the temperatures existing in the various parts of the system. This, in the case under consideration, would be $(200° + 160°) \div 2 = 180°$ F.

The author shows that by Hood's method an effective head may be found and expressed in terms of water at 200 F., but applied to a body of water of an average temperature of 180° F. He concludes, therefore, that Hood's figure should be reduced.

Baldwin's method of calculating is precisely that recommended by Hood, but he uses tables of expansion which are slightly different. Professor Carpenter, however, gives a very different method. He considers that the two columns of water at different densities may be compared to two weights connected by a weightless cord passing around a frictionless pulley.

Mr. Dolby refers to a table of velocities which Professor Carpenter calculates would be produced in pipes, supposing they were frictionless. The author states that, for practical purposes, such a table appears to be useless and states his belief that Carpenter's effective head formula is only applicable, if at all, to the moment when the circulation is about to start.

The author favors Reitschel's formula:

$$h \times \frac{y'' - y'}{\frac{y' - y''}{2}} = \text{effective head}$$

where h = the height of the water column in feet, y″ the specific gravity of the water in the return pipe, and y′ the specific gravity of the water in the flow pipe. Although this formula gives an available head precisely double that found by Professor Carpenter's method, the author states that it is not so easy as it might appear to discover which is more nearly accurate, the factors including a correct estimate of the frictional resistance of the internal surface of the pipes used, the enormous variation in the carrying capacity of a given size of pipe, produced by a variation in the state of the surface of that pipe; also the dimnunition in the viscosity of water as the temperature increases.

FLOW OF WATER IN SYSTEM

Passing to the volume of water necessary to be carried through each portion of the system, the author assumed that the preliminary estimates for the design of a hot-water heating system have been made, and it is now desired to know what is the head absorbed by friction in each portion of the system, and then taking the sum of the heads, to compare this sum with the available head obtained by previous calculations. Should the sum of these heads absorbed by friction be greater than the available head, it will show clearly that an adequate flow in the system could not be maintained, and some portion or the whole of the pipes will have to be made of larger diameter, while, if the two were equal, it would prove the assumed pipe sizes to be suitable.

The author then shows that the formulæ for the flow of water give as great discrepancies as in the calculation of the available head, largely due to the fact that most of the data available were obtained from tests at low velocities with cold water on mains of various diameters, but usually above 2 in.

The author assumes a simple case, to show these discrepancies, in which the heads are required to cause a flow of water at velocities of 1 ft., 1.5 ft., 2 ft., or 2.5 ft. per second through a straight length of 100 ft. or clean cast-iron pipe 3 in. internal diameter.

Five different authorities are quoted, including Reitschel and Carpenter and the figures run from 0.194 to 0.5 ft. to produce a velocity of 1 ft. per second; from 0.437 to 1.15 to produce a velocity of 1.5 ft.; from 0.65 to 1.98 for a velocity of 2 ft.; and from 1.21 to 3 for a velocity of 2.5 ft. per second. The lowest figures, in each instance, are those of either Reitschel or Carpenter or both. The author calls attention to the fact that in any ordinary building the velocity attained with gravity circulation will not exceed 1 ft. per second, and, in most cases, it will be considerably less. He favors the higher figures given above for gravity circulation and the lower heads for reinforced circulation. The author also holds that the same formula will not hold good for all the velocities found in practice, there being a point at which a formula applicable for the lower velocities ceases to be correct and the same way with the high velocity formulæ. In this connection he quotes Professor Unwin's statement that the resistance to the flow of water through a given pipe is 25% less if the water be at 160° F., than if the water be at 57° F.

Heating and Ventilating Two School Buildings from a Central Plant

By Samuel R. Lewis

The construction of a new school building in Decatur, Ill., at a point not far from a similar building in which the heating and ventilating apparatus was to be remodeled, led the school authorities to decide upon a central heating plant from which electric light and steam for power and heating purposes could be supplied to both schools.

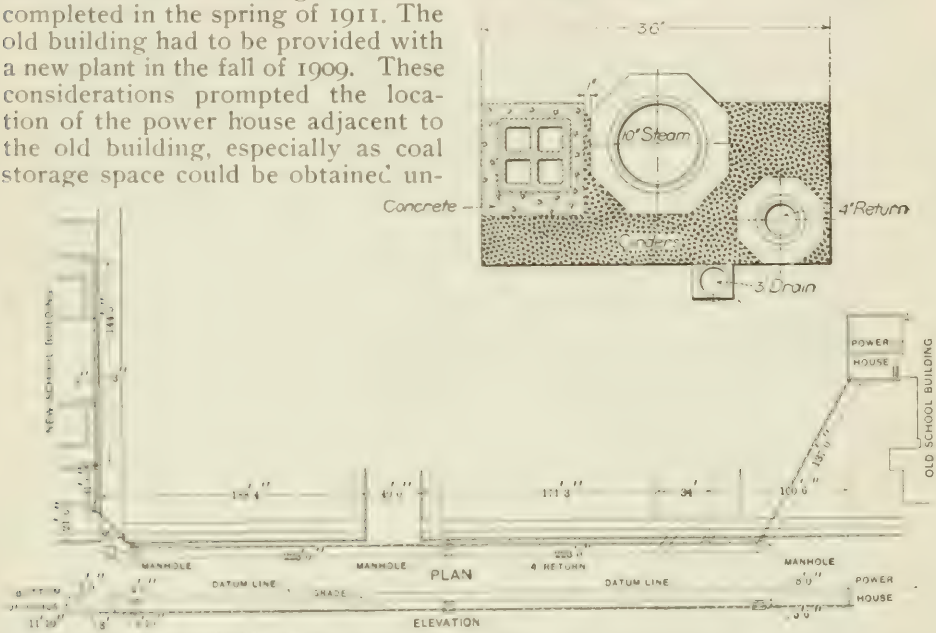
The work presented many interesting features which were described in detail by Samuel R. Lewis in a paper presented at the recent semi-annual meeting of the American Society of Heating and Ventilating Engineers in Chicago.

The new building is about 500 ft. distant from the old building, which was formerly heated, Mr. Lewis, stated, by ten warm air furnaces. The ground space for the new building and its surroundings made it desirable to eliminate from it any boiler plant, and the fact that the furnaces in the old building were worn out at the time of the designing of the new building rendered it

necessary to install new heating and ventilating apparatus there.

The old building is of non-fire-proof construction, hence it was proper to remove all fire from within it. The new building was to be completed in the spring of 1911. The old building had to be provided with a new plant in the fall of 1909. These considerations prompted the location of the power house adjacent to the old building, especially as coal storage space could be obtained under it, and it would be possible to provide enough capacity to handle the old building through the winter at minimum cost.

It was planned to provide the most efficient and economical type of apparatus known, with ventilation of all rooms up to at least 30 cu. ft. of air per minute per pupil, with new sanitary apparatus, all of the ventilated type, and power for fan propulsion, lighting and manual training machinery in both buildings. Steam, return and electric conduits were permitted under the streets by special arrangement with the city.



UNDERGROUND CONDUIT FOR SUPPLYING HEAT AND ELECTRICITY TO THE NEW SCHOOL BUILDING

ADVANTAGES OF INDIRECT HEATING

It was decided to install the indirect type of heating, well governed by automatic regulation, as being the most positive and sanitary, as well as economical. Prominent advantages of this system are:

1. It is ordinarily difficult or impossible to hold school without running the fans and securing ventilation.

2. The pupils in a given room are all subjected to the same temperature and some are not overheated, as they must be when direct radiators are placed in the rooms.

3. The trouble and noise of air valves and steam and water circulation in the radiators are eliminated.

4. The false air circulation by direct radiators destroying diffusion of the fresh air is eliminated.

5. The all-indirect plants are found to be more economical of fuel.

COST OF HEATING SCHOOLS IN CHICAGO AND KANSAS CITY

The following data may be of interest:

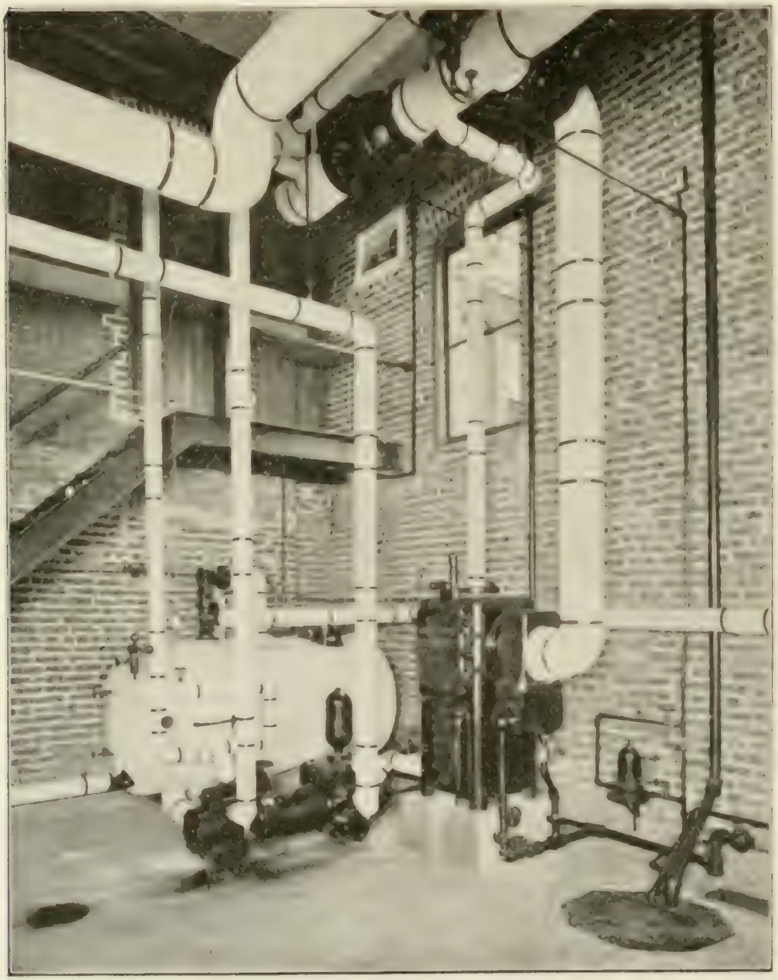
Chicago: Five schools, with both indirect and direct heating, all of about the same size, averaged, per cubic foot of space heated and ventilated per season, 1.11 lb. of coal. Five other schools of approximately the same size, burning the same kind of coal in the same sort of boilers but having indirect heating, averaged, per

cubit foot of space heated and ventilated per season, only 0.67 lb. of coal.

Kansas City: The Manual Training High School, having both indirect and direct heating, cost in fuel, for the year 1909-10, per cubic foot of space heated and ventilated, 0.273 cents. The Westport High School, having entirely indirect heating, cost in fuel for the same year, per cubic foot of space heated and ventilated, 0.124 cents. Both buildings burn oil in similar boilers.

DIRECT RADIATION INCLUDED IN EQUIPMENT OF DECATUR SCHOOLS

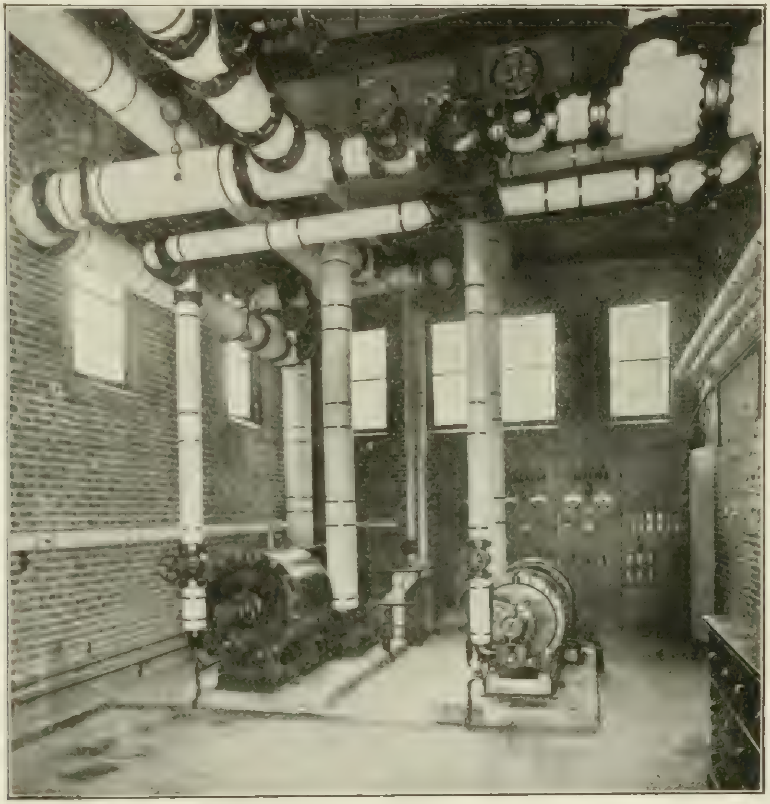
In the Decautur plant direct radiation is used in all toilets, offices, corridors or rooms with plumbing which might be injured by excessive cold. The advantage of having direct radiation in class rooms is that it tends to keep them warm when the fans are not in operation, provided they are furnished with steam. At Decatur the buildings were arranged in such a manner that it was possible to group the indirect radiation in small chambers near the



AUXILIARY APPARATUS AND PIPING IN POWER HOUSE

banks of flues, and thus by gravity air circulation keep the rooms reasonably warm without any direct radiation when the fans were not in operation. This has proved in practice to work out with remarkable success.

and one of 75 K.W., the other of 50 K.W capacity. Together they have ample power to carry all of the lights and power in both buildings at one time. In actual practice, however, the peak load never has overtaxed the smaller machine.

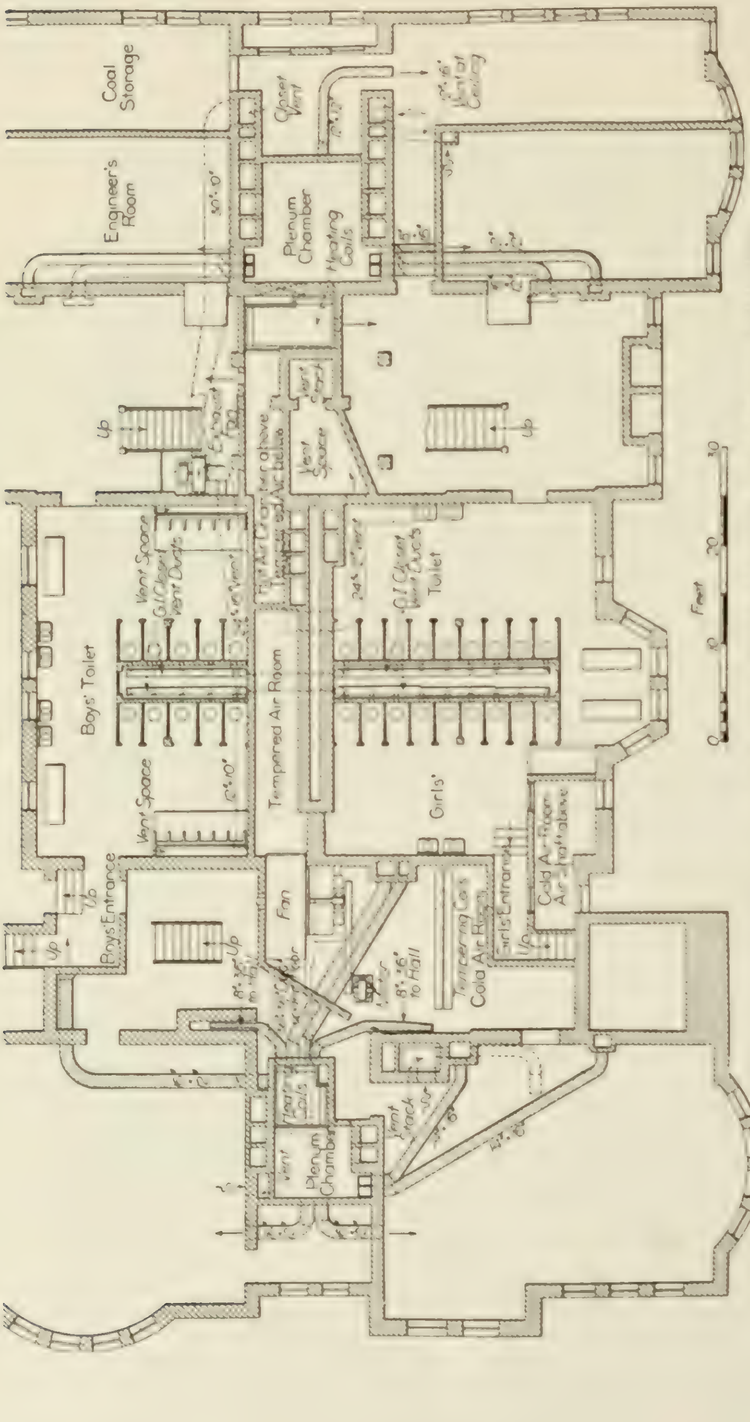


STEAM TURBINES AND PIPING IN THE SCHOOL POWER HOUSE

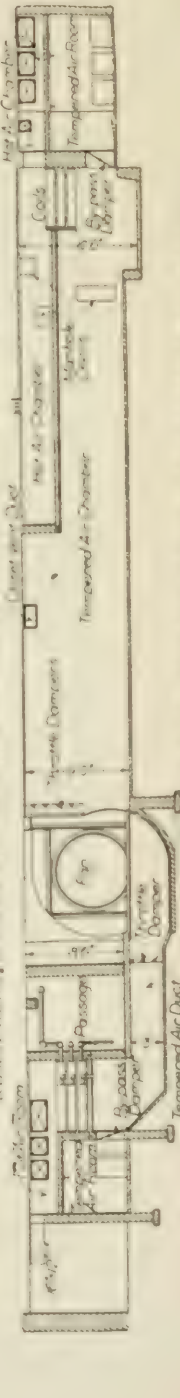
EQUIPMENT OF POWER PLANT

The boiler house is a fireproof building, containing three high-pressure horizontal tubular boilers of 450 rated horsepower, with standand equipment for bituminous coal. In a room adjoining the boilers are located the feed-water heater, boiler feed pumps, all main operating valves, pressure regulator, etc., and two horizontal turbine-generators, with the accompanying switchboards. The distribution lines for steam, compressed air and electricity center in this room. The generators are for 250-volt direct current,

It is admitted that the turbines are not as economical of steam as would be reciprocating engines, but the fact that the plant is in service practically at no time when heat also is not required, and that, therefore, the electricity is practically a byproduct disposes of this argument. The turbines are practically noiseless, have a very long life, require no internal lubrication, thus relieving the boilers of oil, and they occupy very little space. The feed water heater is of only 150 H.P., being used merely to purify the makeup water, or to supply one boiler



REMODELED SCHEME OF HEATING AND VENTILATING IN OLD SCHOOL BUILDING



SECTIONAL ELEVATION THROUGH THE REMODELED HEATING AND VENTILATING PLANT

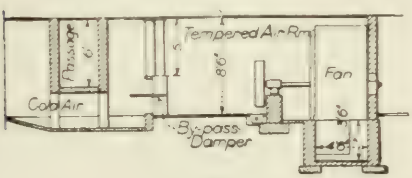
when exhausting to the atmosphere in warm weather, when the plant might be in operation for power or lighting.

STEAM MAINS

To the old building are run a 7-in. steam line and a 2½-in. wet return. To the new building in a common trench, running about 650 ft. and from 4 to 12 ft. underground, are carried a 10-in. steam and a 4-in. wet return, in tin-lined Wykoff insulation, and a four-part vitrified tile electric conduit, as shown. The main to the new building pitches upward from boiler house, and as it is below the receiver, the condensation in it is raised to the receiver by a tilting trap. Proper expansion joints and anchorages are inserted, the former accessible in brick manholes.

EQUIPMENT OF OLD BUILDING

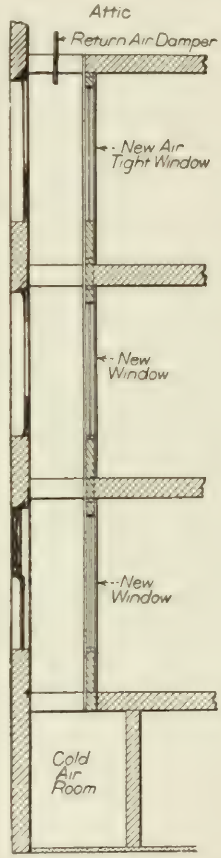
In the old high school the supply fan is a special Sirocco wheel driven by a belted 15-H.P. motor, delivering tempered air to horizontally placed reheating coils in plenum chambers directly at the bases of the flues. Fresh air is drawn from the second-story level. All toilet rooms have special closets, with large rear local vent openings, and all urinals are locally vented, being connected by metal ducts with an exhaust fan, which is driven by a direct connect-



AIR PASSAGE TO FAN, OLD BUILDING

ed 2½-H.P. motor. New flues of tile supplement the old flues and in the attic are placed cut-off dampers in all vent flues for shutting off the ventilation when the building is not occupied. This is effected by compressed air from the engine room.

All class rooms have automatic temperature regulation, the thermostats gradually moving mixing dampers in the plenum chambers without curtailing the volume of air, merely changing its temperature as required. Cumulative devices are installed, by means of which the power of the entire plant finally goes

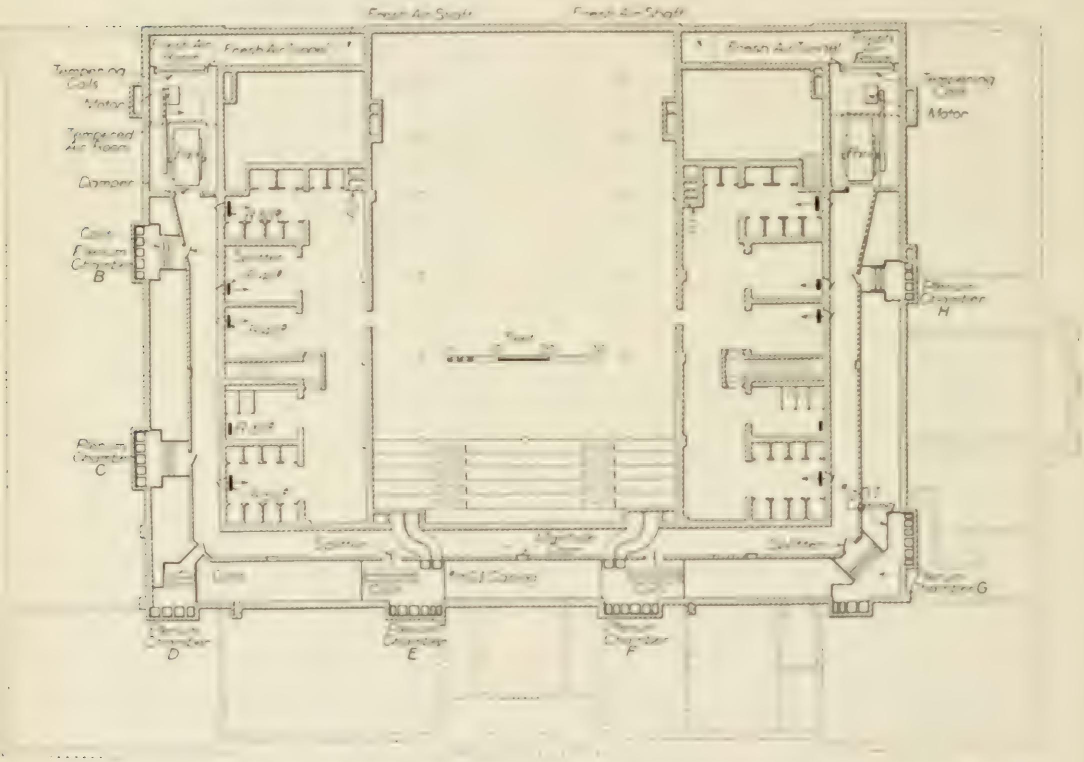


AIR INTAKE, OLD BUILDING

to the slowest room to reach 70° F. when warming the building in the morning. On all side wall air supply openings are placed adjustable diffusers, by which the air current may be deflected to any part of each room. There are no vent screens or registers in the new building, the ventilation outlets being finished as far as visible like the rooms, and thus they are swept out every day, preventing the unsightly accumulation of dust, chalk and paper common when screens are used.

The old school building has an air delivery of 43,000 cu. ft. of air per minute, and about 3,600 sq. ft. of in-

direct radiation. The air blown into the corridors finds its way out through the toilet rooms, through the locally vented fixtures, and thus there is always a greater air pressure in the former than in the latter, effectually preventing odors from the toilets anywhere in the building. for easy inspection, and can be flushed out with a hose. It is well lighted with electricity. It will be noticed that there is very little use of metal duct work. By closing the doors to the various other coils the auditorium or gymnasium may be ventilated or heated by either fan,

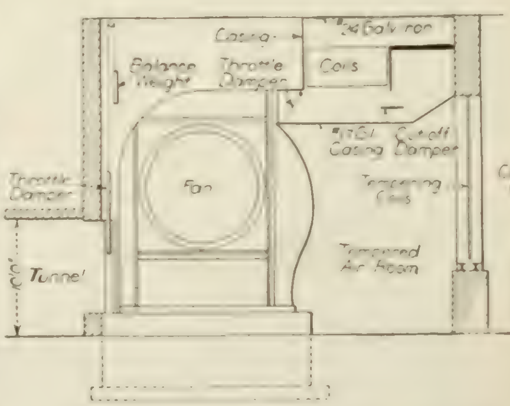


BASEMENT PLAN OF NEW BUILDING SHOWING HEATING AND VENTILATION SCHEME

The toilet ventilation is entirely separate from the room ventilation.

EQUIPMENT OF NEW BUILDING

The new high school was naturally an easier and more symmetrical problem, but the description of the apparatus in the old building will very nearly suffice for the new one. The fresh air is drawn from the second floor level, tempered and delivered by the fans into a tunnel which extends under the center of the corridor, around three sides of the building. In this tunnel are nine groups of reheating coils and all of the piping for steam and condensa-

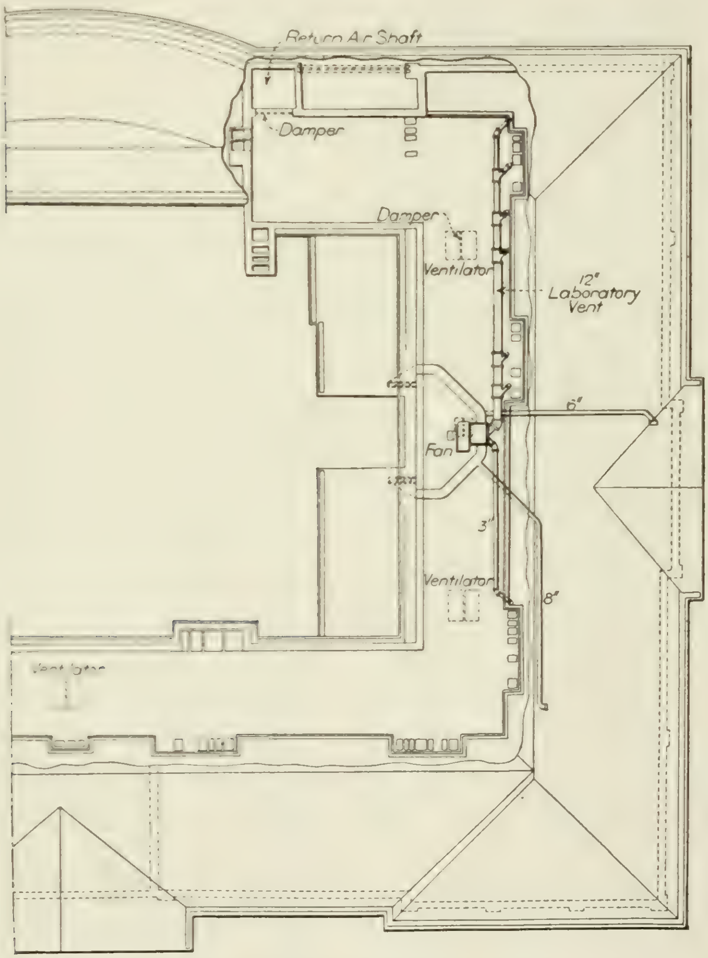


FAN ROOM DETAIL, NEW SCHOOL BUILDING

tion. The tunnel is of ample size without affecting the balance of the building. The supply fans are Sirocco wheels in double discharge housings propelled by 20 H.P. belted motors. The building receives 120,000 cu. ft. of air per minute, and there are about 9,000 sq. ft. of indirect radiation.

cial corrosion resisting construction. A large, tight foul-air chamber is formed in the roof space, from which the foul air escapes through ventilators, equipped with compressed-air controlled dampers as described for the old building.

In both the old and new buildings the foul-air chambers in the attic



EXHAUST AND RETURN CIRCULATION IN NEW BUILDING

Exhaust fans for toilet and chemical table ventilation are placed in the attic. Together they have a capacity of 150,000 cu. ft. air per minute and have 8 H.P. in motors. The chemical laboratory ventilation is carried in vitrified tile pipes, and the fan which handles the fumes is of spe-

may be thrown in connection with the fresh-air intake flues, thus forming a closed circuit, through which the air may be recirculated over and over positively, and a substantial fuel saving is thus effected when warming the building prior to occupancy.

THE HEATING AND VENTILATING MAGAZINE

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WITHIN the past month two of the largest manufacturers of heating apparatus have inaugurated the publication of so-called house organs which, from the character of their reading matter, might properly be described in more ambitious terms. Judging from the initial issues of these publications, this step cannot fail to be helpful to the trade in disseminating more widely knowledge of good heating practice. At the same time, it emphasizes an important trend among manufacturers everywhere in the way of enlarging their functions as advisers, not only of the public, but of the trade as well. This has seemed to many to be the logical course of events. With their unrivalled facilities for investigating the various theories and other problems that arise in the profession, the manufacturers have always been in a position to instruct the trade. This was illustrated in a striking way in a recent discussion of the practice of free engineering when the remark was made that it is not so long since engineers would not undertake to specify vacuum heating installations, and even fan systems, without first securing the guarantee of the manufacturers as to the correctness of their design, as well as their successful operation.

It seems more than possible that the modern type of house organ is to be the key to the question involved in the subject of free engineering. With the growing realization that engineering secrets are becoming out of place, it is fair to assume that the house organ will be an important channel through which the manufacturers will impart their discoveries to the trade.

THE final steps in the organization of the Institute of Operating Engineers deserve more than passing notice among heating engineers. The trade is becoming more and more concerned over the operation and care of heating and ventilating apparatus and the testimony of all indicates the necessity of a better-trained operating force. In this connection, the institute has developed a scheme of co-operation with the public schools by suggesting courses of instruction designed to increase the efficiency of operating engineers generally and to establish close relations between the school, the shop and the power plant. In this way it is proposed to make the certificate of membership in the institute a document of practical value, while the various grades of membership established by the institute are expected to furnish the incentive to promote proficiency.

Legal Decisions

Guaranty of Steam Heating Plant

In an action to foreclose a mechanic's lien for material and labor, the defense was that the plaintiff took the contract to install a steam-heating apparatus in the defendant's apartment house and guaranteed that the same would heat the house to a certain temperature; that the plaintiff did install the heating plant; that the defendant had paid the full contract price therefor; that the apparatus failed to heat the house, as provided in the contract of guaranty; and that the plaintiff furnished the materials and did the work for which the lien was claimed for the purpose of making good the guaranty. The guaranty read: "When the apparatus herein proposed is finished in accordance with the above specifications, I guarantee that it will heat all rooms and halls in which radiators are set to a temperature of 70° F. in the coldest weather."

The plant was installed and the contract price paid, and thereafter the defendant requested the plaintiff to install the pump for which the lien was claimed. From the testimony it appeared that it was impossible to heat the rooms in the building with the original apparatus in cold weather. The defendant company's president testified that it worked properly when it was first tested, but that in cold weather in some of the radiators one coil would heat and the balance remain cold, and in others only two or three of the coils would heat, and that the temperature was far below 70°; that it was so cold that the tenants threatened to leave and some of them did move out. He also testified that he called the attention of the plaintiff to the matter, and called in another steam heating man to examine it, and that upon such examination it developed that the discharge pipes were trapped, so that the cold water in the radiators could not be forced out, and that, if an exhaust pump was put in to exhaust the water from the discharge pipes, it would heat satisfactorily; that something had to be done right away, and that he told the plaintiff to put in the pump; that when the pump was put in and started, it pumped the water out of the discharge pipes and the heating apparatus worked properly, heated all the coils in the radiator, and heated the entire building, in compliance with the contract. There did not appear to have been much discussion between the parties on the subject, but it appeared that the plaintiff gave the defendant a catalogue containing a description of the pumps; that the defendant examined this catalogue and told him to send for and install this particular pump, and that there was nothing said at that time about who should pay for it.

The court held that the plaintiff could not recover. Had the defendant insisted upon having the defect remedied in some particular way, as by the installment of this pump, and it had failed to remedy the defect, it might have been held responsible for choosing an unreasonable method. But no attempt was made to show that the remedy was not a reasonable one, or, in fact, that it was not the cheapest and best remedy available. The conditions of the guaranty had not been complied with, it was the duty of the plaintiff to make good his contract, and it had been made good by the installment of the pump.

Yundt vs. Schultz-Degginger Co., Wasington Supreme Court, 113 Pac. 760.

Governor Dix Vetoes Bill for Separate Bidding on Heating and Plumbing Work

Due largely to the efforts of the New York State Association of Master Plumbers, a law was recently passed by the New York State Legislature to take effect September 1, providing for separate bidding on heating, ventilating, plumbing and gas fitting of State, county and municipal buildings. The measure, however, was vetoed by Governor Dix on the ground that it would involve increased expense to the State.

The bill, which is known as the Senate bill, introduced by Senator T. D. Sullivan, of New York, amends Section 1, Article 5 of Chapter 29 of the laws of 1909, by adding the following new section:

Section 88. Separate specifications for certain contract work. Every officer, board, department, commission, or commissions, charged with the duty of preparing specifications or awarding or entering into contracts for the erection, construction or alteration of buildings in any county, or city, or the borough of any city, when the entire cost of such work shall exceed $1,000, must have prepared separate specifications for each of the following branches of the work to be performed: 1. Plumbing and gas-fitting. 2. Steam-heating, hot-water heating and ventilating apparatus. Such specifications must be drawn so as to permit separate and independent bidding upon each of the classes of work enumerated in aforesaid subdivisions; and all contracts hereafter awarded must conform to this requirement by being separately awarded, it being provided that the firms or corporations shall be responsible and reliable. The authorities in charge of any county or municipal building, however, will as at present be permitted to have such work done as may be deemed advisable by their regular employees, or in the case of public institutions, by the inmates thereof.

Section 2. Article 2 of Chapter 58 of the laws of 1909, entitled "An act relating to state finance, constituting Chapter 56 of the consolidated laws," is hereby also amended bv adding at the end thereof a new section, No. 50, to read as follows:

Section 50. Separate specifications for contract work for the state. Every officer, board, department, commission or commissions charged with the duty of preparing specifications or entering into, or awarding contracts for the erection, construction or alteration of buildings for the state, when the entire cost of such work shall exceed $1,000, must have prepared separate specifications for each of the following branches of work to be performed: 1. Plumbing and gas-fitting. 2. Steam-heating, hot-water heating and ventilating apparatus. As in the case of counties and municipalities, it is likewise provided that said contracts shall be let out to separate and responsible bidders, except that the authorities of public buildings as hereinbefore noted shall have the power to have work in such institutions done by the regular employees, or the inmates as the case may be

Current Heating and Ventilating Literature

Under this heading is published each month an idex of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

BLOWERS

A New Design of Blower for Increased Efficiency. A. H. Anderson. Illustrates and describes a new construction for air blowers, claiming better results than the older designs. 2000 w. Eng News.—May 11, 1911. 20c.

SHOP HEATING

Heat Calculations in Factory Heating. H. C. Russell. Hints on systems of air distribution, and calculations for blower work. 1200 w. Met Work—May 27, 1911. Serial. 1st part. 20c.

VENTILATION

Ventilation Equipment Hotel Sherman. Illustrates and describes details of heating and ventilation, including automatic temperature regulation, air purifying and cooling, in a 12-story building in Chicago. 2200 w. Metal Work—May 13, 1900. No. 23205

Heating and Ventilating the Yarrow Home. An account of a series of interesting experiments showing that air outlets sometimes become inlets, and the results in spreading an epidemic. 200 w. Sci Am Sup—May 27, 1911. 20c.

Death of James Mackay

James Mackay, vice-president and secretary of the Kellogg-Mackay Co., Chicago, died at his home in Chicago, July 18, of typhoid-pneumonia. He had been ill but a few weeks and his condition was not thought to be serious until within a week of his death. He was unable to be present at the recent mid-summer meeting of the American Society of Heating and Ventilating Engineers in Chicago, and a resolution of sympathy and good wishes for his recovery was passed at that time. Funeral services according to Masonic rites were held at his home in Chicago and the body was then taken to Montreal for interment. Among those present at the funeral were his brothers, William M. Mackay, of New York, and Alexander Mackay, of Montreal; also his sister, Mrs. Robertson, of Montreal. Mr. Mackay is survived by a widow and one daughter. He also leaves five brothers and three sisters.

Few men in the heating industry were better known or were held in higher esteem by a host of acquaintances than Mr. Mackay. Possessed of a genial nature coupled with a rugged honesty of character inherited from his Scotch ancestry, Mr. Mackay early won the confidence of his associates and attained a prominence that led to a career of unusual success, both in commercial life and in other activities with which he was identified.

He was born in Montreal, Que., in 1853. He secured his early training in a heating and plumbing shop in that city. One of his first appointments was that of western manager of the boiler department of the Richardson & Boynton Co., of New York. Later he became Chicago manager for the American Boiler Co., where he was first associated with C. V. Kellogg. When this company was merged into the Kellogg-Mackay-Cameron Co., on January 1, 1898, Mr. Mackay was chosen vice-president and secretary. This position he held until his death, although the title of the company was later changed to the Kellogg-Mackay Co.

Mr. Mackay was a charter member of the American Society of Heating and Ventilating Engineers and held many important offices in that organization. He was elected president of the society in 1909 and also served as president of the society's Illinois Chapter.

He was also a member of the Central Supply Association, Illinois Athletic Club, St. Andrew's Society and was president of the City Jobbers' Credit Association in Chicago. As a Mason he was affiliated with the Rogers Park Lodge and Chapter of St. Bernard's Commandery.

Canada's Asbestos Supply

According to an official report, Canada produces 82% of the world's supply of asbestos. The companies operating asbestos quarries and factories in Canada are capitalized at $24,290,000. In 1880 only 380 tons of asbestos were produced in the Dominion, valued at $24,700; in 1909 the output was 63,300 tons, valued at $2,300,000. In 1909 2,000 men were employed in the asbestos industry, and received wages amounting to $1,350,000. In the Black Lake quarries, in the Province of Quebec, there are 45,000,000 tons of asbestos rock in sight. The Russians are the only real rivals as regards extent of asbestos resources, but are heavily handicapped by the excessive cost of transportation of $35 to $40 per ton from the Russian mines to London. Serious competition is not feared by the Canadian companies on this account.

A Home-Made Hygrometer

Directions for making a simple, yet fairly accurate, type of hygrometer are given by E. R. Pritchard, secretary of the Chicago Department of Health, as follows:

Cobalt chloride	5 drams
Sodium chloride	150 grains
Calcium chloride	40 grains
Gum arabic	80 grains
Water	2 ounces

Dissolve carefully, and then soak thin white muslin in the solution and wring dry; when dry, cut into strips for use and hang up in rooms where indications are desired. The muslin strips when dry are blue; when moist they are pink or red. If the air in your room contains 70% relative humidity, the muslin indicator, prepared as directed, would show pink. If there be only 60% or less, the color will be blue. If the strip assumes a greyish color, inclining to pink, it would indicate a relative humidity ranging from 60% to 70%.

New Office Building for the H. W. Johns-Manville Co.

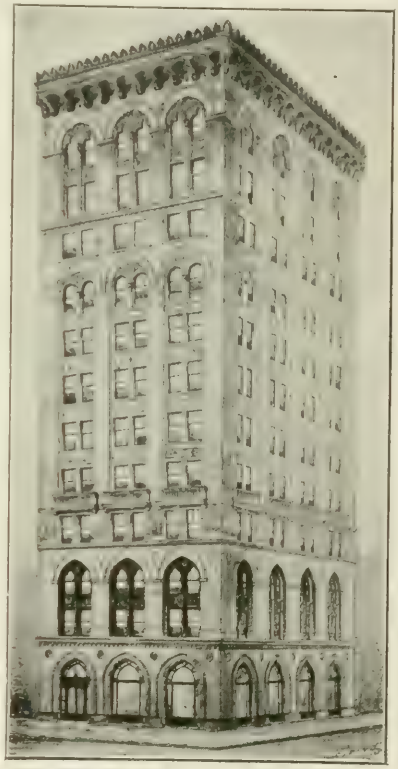
The accompanying photograph shows the new 12-story office building being erected at 41st street and Madison avenue, New York, for the H. W. Johns-Manville Co., who will occupy it in its entirety about May 1, 1912, as the general offices and New York salesrooms of the concern.

The large windows on the lower stories will be of bronze, and the vestibule and entrance hall of Italian marble. The entire ground floor will be devoted to the retail department.

There will be a mezzanine gallery with bronze rails and a marble stairway, with bronze railing, leading up from the first to the second floor. Each floor will be devoted to one or more departments. The executive offices will occupy the eleventh floor, while the twelfth floor will be used as a sample and exhibition room.

The building will be known as the "Johns-Manville Building," and will have the unique distinction of being one of the few 12-story structures to be entirely occupied by a manufacturing concern for office purposes only.

The building will be of fire-proof steel construction throughout, and will



NEW JOHNS-MANVILLE BUILDING, NEW YORK

contain two Otis passenger elevators of the latest type. Each floor will have an area of 2,500 sq. ft., or a total area for the twelve floors and basement, which will extend under the sidewalks, of 34,500 sq. ft.

An unusual feature connected with this building will be the fact that the tenant manufactures and will furnish a considerable part of the equipment of the structure, such as J-M asbestos roofing, asbestos plaster, linolite system of lighting, J-M conduit for wiring, flushometers, J-M sanitor seats, electrical accessories, waterproofing, Keystone hair insulator, asbestos wood, fire extinguishers, asbesto-sponge felted and asbestocel pipe coverings.

Including the space to be afforded in the new general offices, the H. W. Johns-Manville Co., at the present time, occupies in all of its various branches, offices and factories, 2,657,160 sq. ft. of floor space, or about 61 acres.

The 5,000 employees of the company would in themselves form a good-sized little city. Included in this array of employees are 406 salesmen. In addition, the company has extensive European offices.

National District Heating Association

President A. D. Spencer has appointed the following committees which were provided for at the association's recent convention in Pittsburg:

STATION RECORDS

E. J. Kiefer, So. Bethlehem, Pa., and F. R. Wetherell, Peoria, Ill.

RATES

R. D. DeWolf, Rochester, N. Y., and J. J. Hecht, Chicago.

METERS

F. C. Chambers, Springfield, Ill.; George W. Wright, Baltimore; D. S. Boyden, Boston, and C. H. Spengler, Dayton, O.

MEMBERSHIP

A. C. Rogers, Toledo, O.; Warren Partridge, Springfield, Ill.; Charles R. Bishop, Lockport, N. Y.; Byron T. Gifford, Chicago; E. B. Tyler, Pittsburg; C. E. Evans, Jr., Pittsburg; Frank K. Chew, New York; J. E. Bordley, Detroit, Mich.; E. C. Richardson, Providence, R. I.; E. J. Kiefer, So. Bethlehem, Pa.; and W. J. Kline, Lockport, N. Y.

The address of D. L. Gaskill, secretary of the association, is at Greenville, O.

For An Association Emblem

A design for an association emblem is being prepared by George W. Wright, of Baltimore, and R. D. DeWolf, of Rochester, N. Y., for use on stationery, as well as on association buttons.

Institute of Operating Engineers

The first annual convention of the Institute of Operating Engineers will be held in New York, September 1-3, 1911, at the Engineering Societies Building, 29 West 39th street, New York. The business will include the adoption of a constitution, by-laws, educational requirements, apprenticeship requirements, regular study courses, list of books, etc.

New Book

Drying Machinery and Practice, a handbook on the theory and practice of drying and desiccating, with a classified description of installations, machinery and apparatus, including also a glossary of technical terms and bibliography, is an exhaustive work from the pen of Thomas G. Marlow, an English specialist. The book is intended to give an insight into the art of drying and, with this end in view, the general principles which govern the various methods of removing moisture from all kinds of materials are stated, followed by a summary of the various methods employed, together with tables of calculations necessary to decide the requisite capacities. Many typical examples are presented, with adequate illustrations, of drying plants for drying a wide variety of materials. The author states that so vast a field of research was opened up in this connection, owing to the innumerable kinds of material to be dried, as well as the varying degree of dryness required, that it was found necessary to add a bibliography which contains references to the entire literature on any desired point.

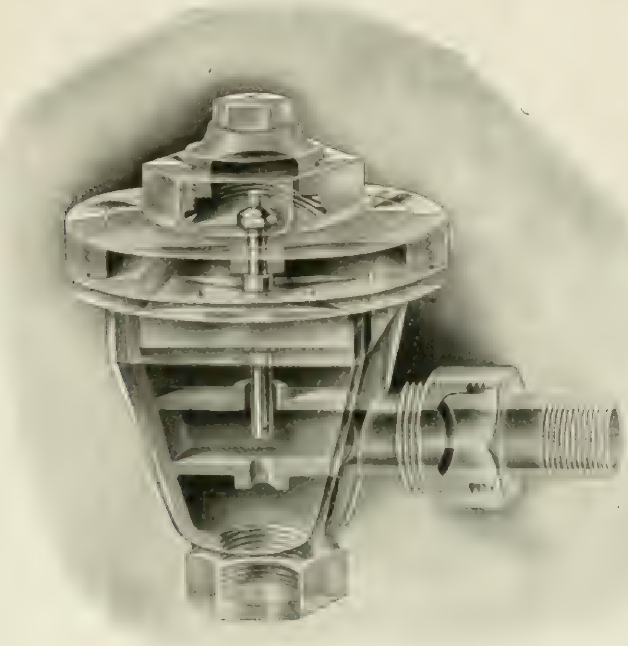
Although the book is devoted largely to English practice, American methods are drawn on extensively, and the fact that no one had written a book in either English, German or French on this subject makes Mr. Marlow's work of exceptional value to all engaged in this branch of engineering. It will surprise many to know the importance of drying machinery in so large a number of trades. The glossary of terms is particularly full and includes explanations of terms, units, symbols and formulae. Size 6x9 in. Pp. 326. 174 illustrations and 22 tables. Published in New York by D. Van Nostrand & Co., 23 Murray street and 27 Warren street. Price, $5.00 net.

NEW DEVICES

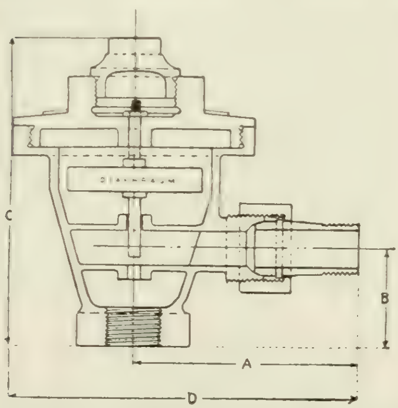
The Kinealy Thermal Valve

Interesting features of the Kinealy thermal valve for Kinealy vacuum and vapor heating systems are that it opens for water and air and closes against steam, is noiseless in operation and requires no jet water. It may be used on pressure systems, as well as on vacuum or vapor systems, and is designed to act equally well for all pressure in the radiator. The valve consists of a shell of substantially square cross section, having an inlet piece by which it is connected to the radiator, and an outlet piece by which it is connected to the return pipe. Inside of the shell there is a bellows of special design, made of two metal diaphragms, of a non-corrosive metal. The bellows contains a volatile liquid which vaporizes at a cer-

tain temperature and causes the bellows to expand and operate a valve piece which controls the flow of air and water from the radiator into the return pipe. The air and water pass from the radiator through the same or different orifices, but their flow is controlled by the action of the bellows. The diaphragms used in the bellows are the Kinealy type used in the Kinealy damper regulators and are susceptible of an unusually large movement.



KINEALY THERMAL VALVE



VERTICAL CROSS-SECTIONAL VIEW OF KINEALY THERMAL VALVE

The manufacturer guarantees that the valve, when properly applied and adjusted, will permit the escape of water and air on any pressure from vacuum to 25 lbs. above the atmosphere without adjusting. It is furnished in three sizes, including ½-in., supplying 250 sq. ft. of direct radiation and draining 75 lbs. of water per hour, ¾-in., supplying 750 sq. ft. and draining 225 lbs., and 1-in., supplying 1400 sq. ft. and draining 420 lbs.

The Kinealy thermal valve is manufactured and sold by the Kauffman Heating & Engineering Co., 2109 Olive street, St. Louis, Mo.

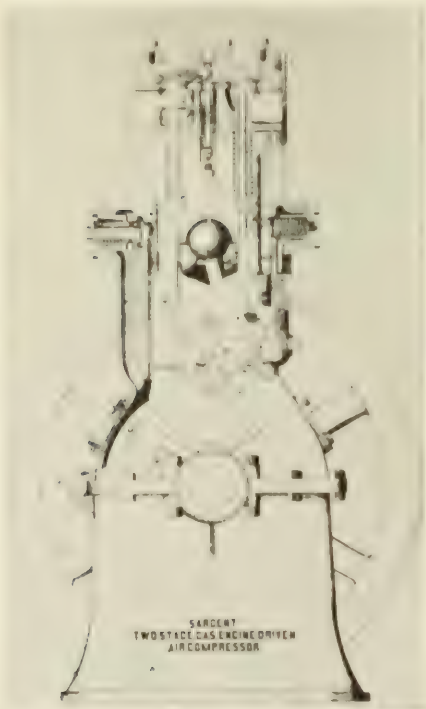
Sargent Two-Stage Gas-Driven Air Compressor

With the increasing demand for compressed air for industrial purposes and its economical compression in large or small quantities, there have been many improvements and refinements in compressors which have increased their efficiency and reliability, yet the thermal and volumetric efficiency of many air compressors is still too low.

To meet the demands for a self-contained, efficient, gas-driven air compressor the machine shown herewith has been brought out. It consists of a vertical gas engine with a differential trunk piston, the annular space around it being used for compressing the air. As there is but one piston, one connecting rod and

one crank shaft for both the gas engine and the compressor, the combined efficiency of the unit is correspondingly increased.

On the up stroke air is drawn into the crank case through the port K, when it registers with the corresponding port on the crank disc J. On the down stroke air is compressed in the crank case and flows through the valve E into the annular chamber made by the differential piston. On the return stroke this air is forced through the discharge valve H and outlet I to the storage tank or receiver, during which time the crank case



SARGENT TWO-STAGE GAS-ENGINE DRIVEN AIR COMPRESSOR

is again filled. On account of the large surface surrounded by cold water and the short distance the heat has to travel when generated in the annular space by compression, the thermal efficiency should be higher than in compressors having a small cooling surface per unit of volume.

The engine proper is of the four cycle type and as air is compressed every stroke the two fly-wheels and crank discs are made heavy to maintain a sufficiently uniform speed.

An inertia governor S, falling slower than the spring seated exhaust valve B, when the engine tends to run above normal speed, allows U to engage V, holding the exhaust valve open and the inlet valve stem W in such a position that X will miss Y and the inlet valve will remain closed. When the speed drops, U will miss V and the engine will resume its normal operation.

Either gas, gasoline or kerosene are used for fuel. When gas is used it is admitted through a graduated valve to the space R from which it flows to the explosion chamber C with the air when the collar Q on the admission valve stem rises. Gasoline or kerosene are taken in through a mixing valve on the air pipe.

Compressed air which the engine compresses is used from a storage tank for starting through the valve N, positively opened at the beginning of each working stroke as long as compressed air is turned on and the pressure is greater than in the explosion chamber. The crank pin is accessible through the hand hole plates, or the piston rod and crank may be adjusted or removed by turning back the cylinder on the hinge k. One sight-feed oil cup lubricates both ends of the piston, and superfluous oil gathered by the narrow groove in piston is delivered through diagonal holes to the ball and, passing half way round, flows through a hole in connecting rod to crank pin. The main bearings are lubricated by heavy grease, which also makes an effectual air seal. Ignition is by jump spark when the primary circuit is closed once in two revolutions by a pin on secondary gear.

Compressors of this type will compress air to 200 lbs. gauge or to any lower pressure at which unloader is set.

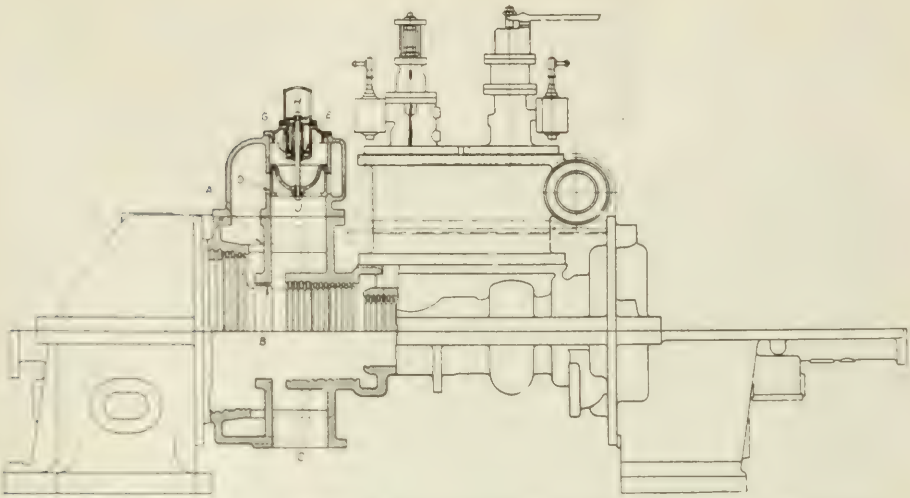
One can control both admission and exhaust, and the valve motion is stated to be quiet, positive and so proportioned that it will run continuously for months without adjustment. These compressors are made in four sizes to compress 9 to 150 cu. ft. of free air per minute. They were designed by C. E. Sargent, M. E., [illegible] West Lake St., Chicago, Ill.

An Automatic Bleeder Turbine

Being of direct interest to the members of the National District Heating Association, the Westinghouse Machine Company, of Pittsburg, Pa., exhibited, during the inspection trip of this association to their works on June 7, 1911, the detail features of one of its new developments in steam turbine design, known as the automatic bleeder turbine.

Its principal advantages result from always using the steam economically before diverting it into the heating system, while at the same time its construction makes it possible to automatically supply large quantities of atmospheric or low pressure steam for central distribution of industrial applications without affecting its electrical output.

A diagrammatic sectional detail is shown



ARRANGEMENT OF STEAM TURBINE WITH BLEEDER CONNECTION AND CONSTANT PRESSURE VALVE

herewith and a description of its operation follows. Generally, the design of the bleeder turbine closely resembles the standard Westinghouse single flow construction. The division wall (A) is introduced and strip packing provided at (B), forming a labyrinth with no mechanical contact. Thus the steam leaving the intermediate stage may flow into the heating system through the nozzle (C) or else, with a reduced heating demand, a part of the steam passes through the valve (D) and performs work in the low-pressure section.

The automatic valve (D) is controlled by predetermined pressure in the heating system and the requisite balacing dead weight on the upper side (H). The piston (E), enclosed in an oil-filled chamber (G), is provided to dampen any sudden movement due to pressure fluctuations.

Thus, if the pressure in the heating system is fixed at 18 lbs. abs. and the pressure at the end of the intermediate section tends to rise, due to an increased turbine load, the valve opening will increase, by-passing a greater portion of the steam to the low-pressure stages. On the other hand, if the load decreases and the pressure at (J) falls, the valve opening will decrease until the pressure is again built up to 18 lbs.

The Westinghouse Machine Company is the patentee and manufacturer of this type of turbine.

A New Automatic Hot Water Regulator and Circulator

A device designed to accelerate the circulation of water in a hot water heating system, thus permitting smaller pipe sizes as well as to regulate the draft in the heater, has lately been placed on the market by the D. & T. Mfg. Co., St. Louis, Mo. The feature of the apparatus is the location of the expansion tank, with its mercury trap, in the basement instead of in the attic. Regulation of the boiler dampers is secured by the action of the water in the system alone, requiring no outside force or energy, the expansion and contraction of the water acting on a diaphragm which operates the dampers.

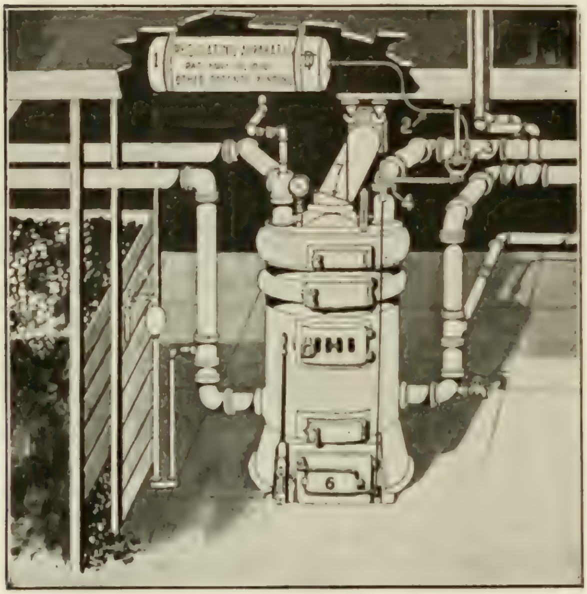
The general arrangement of the apparatus may be seen from the accompanying illustration. The tank shown is an air tank. It is connected to the top of the main flow pipe, near the boiler, by a 1-in. pipe. The relief trap is a column of mercury of sufficient height to hold back 10 lbs. over the altitude pressure and no more. It is connected to the return pipe at a point where sediment will not lodge.

The column of mercury is fixed for a predetermined pressure, above which the system will be relieved. The water being turned into the system, all the air below the tank is confined in the tank and diaphragm. When the system has become filled, the fire is started under the boiler. As the water becomes heated it expands and, the system being closed, having no open expansion tank at the top of the system, the expansion acts to displace the water and, as its only room for expansion is in the tank, the water compresses the air confined in the upper portion of the expansion tank and generates a pressure of approximately 1 lb. for every 20 increase in temperature.

As the pressure is generated, it passes through a lead tube and acts on the diaphragm, causing it to exert its power on a lever which controls the draft automatically. By raising or lowering a perforated plate on the end of the lever the

temperature of the water can be regulated with accuracy. In this way the device may be rendered responsive to the different temperatures required.

By using the device it is claimed that a fuel saving of 30% mav be effected, while the increased circulation over a gravity system will run as high as 50%. The apparatus may be applied to a gravity hot water heating system and a new installation with these devices is said to cost no more than a gravity job.



D & T HOT WATER HEATING SYSTEM WITH EXPANSION TANK IN BASEMENT

The apparatus was invented by John M. Dougherty and Harry C. Tabler, whose initials form the company's title. A company was organized in 1909 and incorporated the following year with a capital stock of $30,000, and the following officers: President, John M. Dougherty; vice-president, James W. Gill; secretary and treasurer, Harry C. Tabler. All of the officers are men of long practical experience in the heating field.

Trade Literature

Webster Vacuum Heating System in the Boston City Hospital is the title of an attractive pamphlet, just published by Warren Webster & Co., Camden, N. J. It describes the installation, with the unusual obstacles to be met, of their "Hylo" or Type D system of heating in 26 buildings of this hospital. The pamphlet will be gladly sent on request, we understand to interested parties.

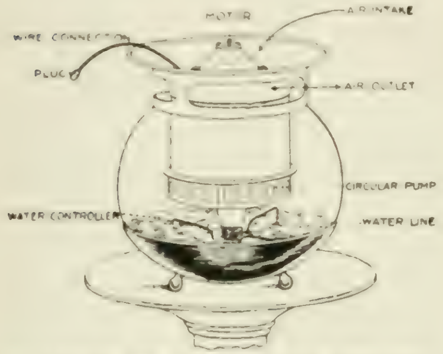
Common Sense Heating and Sanitary Plumbing, a catalogue of noteworthy artistic excellence, has been published by Pierce, Butler & Pierce Mfg. Co., Syracuse, N. Y., and describes the company's line of steam and hot water heating apparatus and sanitary plumbing equipment. The publication is one designed especially for the house owner and contains many practical suggestions for the selection of suitable heating and plumbing apparatus. The illustrations include various types of the company's line of boilers, including the Spence and Modern for hot water, the Touraine for steam, and the American sectional steam and water boilers. A double-page view of the company's plant at Syracuse gives an idea of the size and capacity of this well-known house. Size 6x8½ in. Pp. 32.

Ideal Heating Journal is the title of a new house organ published by the American Radiator Co., Chicago. The publication is gotten up in a manner to reflect credit upon its publishers, both as to contents and presswork. For ten years the company has issued a monthly publication for intercommunication among its employees and the *Ideal Heating Journal* is the outgrowth of this publication. It is printed on a highly coated stock, with a cream-colored cover and has a special border design for the cover, featuring the "Ideal" trade mark. Included among the contents of the initial number, which is dated July, 1911, are articles, with illustrations, on the company's Institute of Thermal Research at Buffalo, "Wrong and Right Way of Buying Coal," "Vegetable Warehouse Heating," "Vento Heaters in School Warming," and an account of a sylphon packless radiator valve that held a vacuum of 27 in. for 30 days, besides a number of miscellaneous items such as descriptions, with illustrations, of the company's new wall radiator steady bracket, a new adjustable check damper, selecting proper tile linings for chimney flues, etc.

What $95 Did is told in a folder that is being sent by the Vapor-Vacuum Heating Co., 96 Drexel Building, Philadelphia, this amount being the cost of heating a four-story building with the Vapor-Vacuum heating system. The building in question is reproduced showing that it is exposed on all four sides. It occupies a plot 30x140 ft. and is four stories high. It contains 2700 sq. ft. of direct radiation, divided into 40 radiators. The manufacturer guarantees a saving of 25% on coal with the use of this system. Other features emphasized

are the absence of pounding in the pipes, in addition to the use of a vapor inlet valve by which the amount of heat admitted to each radiator may be controlled.

What Science Has Done for You is the title of a new folder describing the Duntley air cleaner and purifier, made by the Duntley Manufacturing Co., Chicago, Ill. The construction of this device may be seen from the accompanying illustration. It is designed to purify the air of dust, dirt and germs, as well as tobacco smoke and odors, although, according to experi-



NTLEY AIR CLEANER AND PURIFIER

ments, it has been found capable of reducing room temperatures from 69° to 60°, a reduction of 9°, within a few minutes. A further test, made by placing cracked ice in the reservoir of the purifier, showed a reduction of temperature to 55°, or a reduction of 14°. All of the experiments noted were made in an ordinary living room. The device is operated by a Burke universal electric motor, operated on either direct or alternating current.

A Foundry Heating System, describing the Green equipment for the plant of the Waterbury Castings Company, and Shop Heating and Ventilation, showing the systems used in the Abendroth & Root Mfg. Co.'s plant, are the titles of an interesting reprint which is being sent to those interested by the Green Fuel Economizer Co., Matteawan, N. Y. Special attention is called to the amount of glass surface in the foundry. This foundry is heated by hot air, so distributed that all of the smoke is driven upwards from the floor and removed, while the men are continually supplied with fresh air. The hot blast coils, in the two plants described, are all concentrated in one place and require practically no attention. By using a small amount of heat during the night the foundry is kept at such a temperature that there is no danger of moulds or cores freezing.

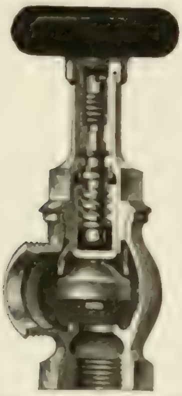
The pamphlet also describes a system of heating for a metal working shop in which the warm air is spread out evenly on the floor where it is wanted, instead of an attempt being made to blow it long distances, which always results unsatisfactorily.

Small Motors, for direct and alternating current, and Electric Dynamometers are titles of two of the latest bulletins issued by the Sprague Electric Works of the General Electric Co., New York. In the first-mentioned bulletin, the small power motors are described in detail, with views of the motors dissembled and also as applied for different purposes. In the second bulletin, the Sprague electric dynamometer, designed to measure the power generated by a gas engine, steam engine, turbine or motor, or the power required to drive any piece of apparatus, is discussed at length, the illustrations including an interesting electric dynamometer power curve with directions for its use. Size 8x10½ in. each. Pp. 16 each.

Catalogue and Price List No. 30 of the Chapman Valve Mfg. Co., Indian Orchard, Mass., is a notable publication of 174 pages, covering the company's line of valves, fire hydrants, indicator posts, sluice gates, shear gates, floor stands, etc. The company is known as the largest and oldest manufacturers of solid wedge gate valves in the country. The company guarantees its goods, the guarantee covering the replacement of defective goods. In addition to the usual details, including illustrations, price lists and dimensions of its various lines, the catalogue contains a full telegraphic cipher code. Special attention is called to the fact that the mixture of all cast iron used in the company's product is governed exclusively by chemical analysis. Sample pigs are taken from each carload received at its works and analyzed by a competent chemist. The coke used in melting is also analyzed. Size 6x9 in. (standard). Pp. 174.

Lavigne Packless Radiator Valves are the subject of an interesting circular issued by the Lavigne Mfg. Co., Detroit, Mich., in which are shown its various types of packless valves, as well as price list and dimensions of each type. In all cases of vacuum heating a good packless valve is stated to be an essential factor, as its use removes the most serious source of air leakage into the system. The Lavigne valve can be fully closed and locked closed by about three-fourths turn. It has a regular composition disc, enabling it to be closed absolutely tight. The stem of the Lavigne valve is of the non-rising type and is provided with a flange a short distance above the cam

thread. Between this flange and the inwardly extending flange of the bonnet is placed a specially prepared composition washer. Another similar washer is placed immediately above the inwardly extending flange of the bonnet, and upon this second composition washer rests a gland shaped follower plate extending from the handle. A shoulder is formed on the inside of this follower plate and



LAVIGNE PACKLESS RADIATOR VALVE

this shoulder supports a spring which bears upwards against a nut screwed to the top of the stem. A double service is performed by this spring, as it bears downwards on the upper composition washer, and at the same time pulls upwards against the lower composition washer, thus holding both of them tightly against the inwardly extending flange of the bonnet and taking up automatically any wear that may occur in either. This is designed to insure an absolutely tight joint against water, steam or air.

The lower end of the stem engages with a cage which is held from rotating by a set of trunnions which slide upwards and downwards in the tubular guides extending downward from the bonnet, so that the cage cannot oscillate from the action of the steam. To this cage the disc holder is attached in a swivel joint manner. The bonnet is carried clear up to the under side of the follower plate to prevent the possibility of injury or interference to the stem

The circular also describes the Lavigne graduated packless valve.

Radiation is the title of what is probably the most ambitious house organ that has appeared in the heating trade. It is published by the United States Radiator Corporation, Detroit, Mich., Vol. 1, No. 1 being dated July, 1911, and is to be issued occasionally under the editorship of George Albert Moore. Unlike most house organs, *Radiation* has a definite subscription price of $1.00 a year, or 10 cents for single copies, and a glance at its contents shows that the term "house organ" hardly applies to a publication of such an interesting character and one made up almost wholly of purely technical matter, the advertisements being practically the only indication that the periodical is allied to any particular concern. The contents include an article by Marion McLaughlin on "Setting the Sun to Work," being an account of the development of the solar heater; "Heating Buildings with Steam," by Roufis St. John, a serial article, the first installment taking up direct systems of heating, one pipe and other systems of piping; a brief account of the heating plant in the Ritz-Carlton Hotel, New York; "The Story of the Match," by George Ethelbert Walsh, illustrating primitive methods of fire-making; and "Fuel and Draft," by James J. Cosgrove, another serial, the first installment including some valuable coal classifications. The publication is of standard magazine size and has a cover in colors illustrating an Eskimo igloo interior with its quaint cooking arrangements. Size 6¾x10 in. Pp. 32.

Why You Are Losing Your Part of $25,000,000 is a well gotten up booklet showing increased effectiveness of workers due to good air. The booklet is published by the Standard Electro-Utilities Co., Chicago, makers of the Vohr ozone maker, and the value of ozone in purifying the air of offices and similar apartments is dwelt on at length. The increased output is shown by typical instances of the illness of high-salaried employees due directly to the stuffy conditions of their offices Attention is also directed to the "3 o'clock sag," as a result of which, it is stated, in Chicago alone over a million dollars is lost every year. A number of fac-simile testimonials are presented, showing how the Vohr ozone makers actually remedy the poor air conditions in offices. The booklet includes price lists and illustrations. Size 3½ in. x 7 in. Pp. 28

Six Little Pointers is the title of a neat little circular published by the McCreery Engineering Co., Detroit. The idea suggested by the title is carried out in the illustration on the cover showing a row of pups. The six pointers, however, are intended to show the most effective way of purifying, cooling or humidifying air. These are given as 1, the drawing of air through a system of water sprays; 2, the use of wet cleaning surfaces; 3, intimate and extended contact of the air with the spray and deflecting surfaces; 4, eliminators to extract free moisture and not for use as cleaning surfaces; 5, movement of air should be the slowest in its passage through the eliminators; 6, purifying device with gushing spray heads. These features, it is pointed out, are contained in the McCreery air washer, manufactured by this company.

H.-O. Pipe Joint Cement, a product of the [illegible] Johns-Manville Co., New York, is the subject of a folder in which [illegible] is made that those who are using ready mixed pipe joint cement are paying [illegible] much per pound for the water or oil it contains as for the cement itself. It is claimed that 1 lb. of [illegible] goes as far as 4 lbs. of ordinary pipe joint cement, yet costs no more per pound. Another advantage of mixing cement for oneself is that it does not dry out and become worthless. H.-O. pipe joint cement, it is stated, does not become solid like red or white lead, and joints made with it can, therefore, be easily uncoupled without breaking the fittings, yet it does not wash out of the pipes.

We're Rounding Up Customers for You [illegible] lished by the H. W. Johns-Manville Co., New York, calling attention to the company's line of J.-M. asbestos roofing. The folder contains reproductions [illegible] ments the company is running, showing the extensive publicity being given to this form of roofing and the consequent demand that is being created. There is also a reproduction of many of the magazines in which J.-M. asbestos roofing is being advertised. Over sixty publications are being used, reaching more than 27,500,000 readers in the [illegible]

New Contracts

F. W. Lamb Co., Chicago, steam heating school building in Lockport, Ill., for [illegible]

John G. Sutton Co., San Francisco, Cal., steam heating and ventilating 11-story building at Montgomery and Sutter streets, San Francisco, for the San Francisco Investment Co., for $2,940.

Alton Plumbing & Heating Co., Alton, Ill., vacuum steam heating system for St. Joseph's Hospital, at that place, for $4,200.

Mangrum & Otter, San Francisco, Cal., heating and ventilating Agricultural Building at the University of California, at Berkeley. The contract amounts to [illegible]

Samuel A. Esswein Heating & Plumbing Co., Columbus, O., heating new court house at [illegible], O., for $5,675.

Bradlee & Chapman, Boston, steam fitting in power house and tunnels at the City Hospital for $12,543. Other bids were: Lynch & Woodward, $14,362; Ingalls & Kendricken, $14,500; W. W. [illegible] & Sons, $15,732.

Lumsden & Van Stone Co., Boston, steam piping system at the Calf Pasture pumping station, Boston, for $6,285.

Paul Grant, Norfolk, Neb., heating, plumbing and electrical work on additions to Lincoln and Grant schools. The work will amount to $8,698.

Elmer Dovel, Auburn, Neb., heating and plumbing new court house at Pawnee City, Neb., for $6,000.

James Hunter Heating and Construction Co., Albany, N. Y., heating addition to School No. 17 for $6,400.

Steward & Blunt, Skowhegan, Me., heating and plumbing new dormitory building at Colby College, Waterville, for [illegible]

Barret Hardware Co., Joliet, Ill., heating Henderson avenue school. A steam plant will be installed, with mechanical ventilation.

C. O. Burrows & Co., Boston, heating and ventilating new Broad street school in Westfield for [illegible]

Advertisers' Index

TRADE AND MISCELLANEOUS NOTES

Deaths

Peter E. Esswein, treasurer of the Samuel E. Esswein Heating & Plumbing Co., Columbus, O., died at his home in that city June 25.

Augustus W. Mott, second vice-president of the J. L. Mott Iron Works, New York, diel July 2. He was 50 years old. He was the son of Jordan L. Mott.

George F. Hughson, president of the Hughson Steam Specialty Co., Chicago, died July 19 at his home in Chicago, after a short illness. He was 51 years old. Mr. Hughson was for many years vice-president and sales manager of the John Davis Co., which was succeeded by the Hughson Steam Specialty Co. in 1909. Mr. Hughson leaves a widow and a son, Harry H. Hughson, who will succeed him in the management of the company.

Robert B. Humphryes, vice-president of the Humphryes Mfg. Co., Mansfield, O., died July 10. He had been in poor health for several years, but the immediate cause of his death was a stroke of paralysis. Mr. Humphryes was 65 years old and was for many years general manager and superintendent of the Humphyres Mfg. Co. until ill health forced him to relinquish activities.

Miscellaneous Notes

Eastern Supply Association held its summer meeting at Atlantic City, June 22. John McClure Chase presided in the absence of President P. M. Beecher. The association's credit bureau reported that out of claims placed with the bureau amounting to $101,000, over 50% had been collected without additional cost to any member of the association.

New York firms which have been in business for 60 years or more have been listed in connection with the anniversary number of one of the New York dailies

[illegible] the following firms that are manufacturers of heating and plumbing goods:- [illegible] Brothers, [illegible] Beekman St.; Boynton Furnace Co., 106 West 37th St.; Bruce & Cook, 190 Water St.; Hitchings & Co., 233 Mercer St.; J. L. Mott Iron Works, [illegible] Fifth Ave.; [illegible] Mfg. Co., 71 Beekman St.; Richardson & Boynton Co., 31 West 31st St.; Rider-Ericsson Engine Co., 35 Warren St., and Tuttle & Bailey Mfg. Co., 76 [illegible]

National Association of Brass Manufacturers [illegible] Detroit, June 27, 1911. The next meeting will be held in Cleveland, [illegible]

Central Supply Association, at its recent meeting in Detroit, June [illegible] elected [illegible] to membership, as follows: [illegible] Heating Co., Chicago; Roberts-Hamilton Co., Minneapolis, Minn.; Novelty Iron Co., Canton, O.; [illegible]

Baltimore, Md.—A plan is being discussed to establish a municipal heating and lighting plant in connection with the [illegible] pumping station now being built on South [illegible] between [illegible] and Pratt streets, Baltimore. The plan is to heat and light the City Hall, Court House and the two City Hall annexes from the pumping station. It is pointed out that the pumping station has [illegible] at all times for an emergency call, while it may not be [illegible] a year. The [illegible] power that must be necessarily wasted could, it is believed, be utilized to advantage for heating purposes. The proposition is being advocated by President John Hubert, of the Second Branch City Council.

Milwaukee, Wis.—The recent hot weather in Milwaukee is responsible for the development of a scheme for cooling buildings in which use is made of the building's steam or hot water heating system. The idea is to fill the system with cold water, maintaining a circulation, if necessary, in the warmest weather, by draining the system at frequent intervals. Several degrees of cooling effect are said to have been obtained in this manner in the home of Samuel Walwig, 218 Twenty-third street.

Cleveland, O.—[illegible] is the term that has been applied to the methods adopted in Cleveland for freshening the air in school rooms, whereby at the sound of the gong the children leave their studies and commence marching exercises, calisthenics or run out into the playground while the doors and windows are thrown wide open for a few minutes.

Mexico, Mo.—The city council has granted a [illegible] franchise to the Mexico Power Co. for a central heating plant, which is to be installed in the downtown district. The Mexico Power Co. owns the waterworks system, electric light plant and gas plant in that place. It is proposed to utilize the exhaust steam from the electric light plant to heat the city. The franchise covers the residence portion as well

Wisconsin Master Steam Fitters' Association [illegible]

Twenty delegates were present. Officers were elected as follows: President, M. E. Flaherty, Milwaukee; vice-president, J. F. Ahern, Fond du Lac; secretary, Fred Kauffman, Milwaukee; treasurer, Otto Biefield, Watertown. It is proposed to hold a convention in Milwaukee in the spring.

United Bunch of Sheep, New York Fold, held its mid-summer [illegible] July 2, at Witzel's Point View Island, College Point, Long Island. A clambake was served. The organization is made up of salesmen in the heating and plumbing supply trade.

International Municipal Congress and Exposition will be held at the Coliseum, Chicago, September 18-30, 1911. As already announced, the subjects which have been decided upon for discussion and the exhibits for exploitation include heating systems for schools, vacuum cleaning equipment and ventilating systems.

Proceedings of the Congress of Technology, held in Boston, April 10-11, will be published in a single volume of about 500 pages, which will be sold at a moderate price. It will contain the seventy-odd technical papers relating to many fields of industry, which were read at the celebration of the fiftieth anniversary of the granting of the charter of the Massachusetts Institute of Technology.

Manufacturers' Notes

McDonald Vacuum and Vapor Specialty Co., Cleveland, O., has taken offices in the new Swetland Building, in that city.

United States Radiator Corporation, Detroit, Mich., announces the appointment of Edward E. McNair as district sales manager with headquarters in Detroit. Mr. McNair has been manager of the company's Chicago branch.

United States Radiator Corporation, Detroit, Mich., is building a 4-story structure at Broadway and Grand River, Detroit, to be occupied as its general offices.

John Simmons Co., New York, manufacturers and dealers in heating and plumbing supplies, has recently completed a large addition to its factory and machine shop at Charlestown, W. Va., to be devoted exclusively to the manufacture of fire equipment specialties.

Mayor-Lane Co., New York, dealers in heating and plumbing supplies, has completed the equipment of its new quarters at 340 Hudson street, where it has nearly 30,000 sq. ft. of floor space. The officers of the company are: President and treasurer, Victor A. Harder; secretary, Victor A. Harder, Jr.; manager of sales, Fred G. Ellis.

Federal Heater Co., Chicago, the $8,- [illegible], whose formation was reported in last month's issue, will enlarge its foundry, mounting shop and furnace manufacturing plant at Oakley, near Cincinnati, O., which was formerly the plant of the Peck-Williamson Heating and Ventilating Co. The full list of officers is as follows:

President, A. W. Williamson, president of the Peck-Williamson Heating & Ventilating Co.; vice-presidents, L. J. Mueller, secretary of the L. J. Mueller Furnace Co.; John Kerch, president of the Twentieth Century Heating & Ventilating Co.; secretary, D. M. Compton, president of the Quaker Manufacturing Co.; treasurer, F. H. Moore, treasurer of the International Heater Co.; directors: above-named officers and W. C. Williamson, secretary of the Peck-Williamson Heating & Ventilating Co., L. E. Wheeler, president of the International Heater Co., Byron H. Edwards, president of the Ideal Furnace Co., Charles Scheible, The Henry & Scheible Co., L. J. Mueller, Sr., president of the L. J. Mueller Furnace Co., George Maag, vice-president of the Twentieth Century Heating & Ventilating Co., and J. H. [illegible], attorney.

"Informant" is the title of a new monthly published by the American Blower Co., Detroit, Mich., for exclusive circulation among its branch managers. In addition to fan data, results of tests, etc., the publication will contain news letters from the company's various offices.

Crane Co., Chicago, has purchased the business of J. A. Roe Co., Detroit, jobbers of heating and plumbing supplies, at Bates and Atwater streets. The business will be continued as a branch of Crane Co. The company is planning to make extensive improvements in the building until now occupied by the J. A. Roe Co.

Automatic Water Heater Co., Rockford, Ill., has completed negotiations with Crane Co., Chicago, whereby Crane Co. will handle its output. Mr. Link, an expert in the experimental department of Crane Co., has had the heaters under test. Mr. Link will be the superintendent of the factory at Rockford. The Automatic Water Heater Co. is capitalized at $25,000, the principal stockholders being Mrs. C. B. Miner and [illegible] Patterson.

National Steam Specialty Co., Chicago, manufacturers of air valves and other steam specialties, has increased its capital stock from $15,000 to $25,000.

Ideal Heating Journal is the title of a new house organ published by the American Radiator Co., Chicago. Volume 1, No. 1, is dated July, 1911. The journal, it is stated, will be devoted to the advancement of the steam and hot water heating industry. Among the contents of the first number is an illustrated description of the company's Institute of Thermal Research at Buffalo, an article on the wrong and right way of buying coal, and a description, with illustrations, of methods of heating vegetable warehouses. Separate items cover features of the company's various specialties and many miscellaneous notes. The publication is attractively gotten up and is a credit to its publishers.

American Engine Co., Bound Brook, N. J., has appointed Harry Marks, 90 West street, New York, as its sole agent in the metropolitan district. Mr. Marks has installed a large number of American-Ball engines, including both simple engines and the American-Ball angle compound types. Special attention is given to the installation of these engines in connection with exhaust steam heating systems.

Hawley Down Draft Furnace Co., Chicago, has secured a nine-acre site in Easton, Pa., on the line of the Lehigh Valley Railroad, where it is planning to build a large plant.

D. Saunders' Sons, Yonkers, N. Y., manufacturers of pipe-threading tools, recently distributed a cash dividend of $35,000 to its [illegible] employees. The distribution was provided for in the will of the late Leslie Saunders, former head of the firm. Fifty of the employees who have been with the firm for nearly 40 years, received over $2,000 each, while the other employees received $1,000 each. The unusual dividend came as a complete surprise to them all.

United States Radiator Corporation, Detroit, Mich., has transferred M. D. Keyes from Minneapolis to the metropolitan district, with headquarters at the company's New York office, 5 West 29th street.

Buffalo Forge Co., Buffalo, N. Y., has secured the services of Frank L. Busey, formerly connected with the Engineering Experiment Station of the University of Illinois. Mr. Busey recently made some exhaustive experiments with house-heating boilers and furnaces, his paper on the subject being reproduced in THE HEATING AND VENTILATING MAGAZINE for July, 1911.

American Radiator Co., Chicago, Ill., is placing on the market a new type of stationary vacuum cleaning apparatus. It is electrically driven.

Chapman Valve Co., Indian Orchard, Mass., announces the removal of its New York office to 138 Centre street. F. W. Sleep is the New York manager, and associated with him is C. F. Weber, who will be welcomed back to the trade in New York by his many friends.

Monash-Younker Co., Chicago, manufacturers of the Monash New Noiseless Radifier Valve, against whom an injunction was issued at the instance of the Consolidated Engineering Co., Chicago, restraining the Monash-Younker Co. from selling or installing the Radifier Valve, announces that the injunction has been suspended pending an appeal.

New Firms and Business Changes

Reading Foundry & Supply Co., Reading, Pa., has been organized to manufacture cast-iron soil pipe and fittings. The company will also handle heating and plumbing supplies. President, John G. Fleck; vice-president, John Chase; treasurer, Fred W. Fleck; superintendent of foundries, Edward Stratton; manager, Walter Sippel. The company has a well-equipped soil pipe foundry in Reading.

W. W. Campbell & Son, Boston, Mass., heating and ventilating engineers and contractors, announce their removal to 40 Haverhill street, Boston.

Mehring & Hanson Co., 307-309 West Washington street, Chicago, is the title of a new heating and ventilating engineering and contracting firm of which George Mehring, of Chicago, is president. The other officers are: Vice-president and treasurer, David N. Hanson, Jr.; secretary, George H. Dickerson. Mr. Mehring, the president, is a prominent figure in the heating trade in Chicago. He is a member of the Chicago Master Steam Fitters' Association and is a charter member of the American Society of Heating and Ventilating Engineers. He was formerly for many years with the L. H. Prentice Co., of Chicago.

New Incorporations

Isolated Steam Heating and Maintaining Co., St. Louis, Mo., capital $2,000. Incorporators: William N. Fisher, John Schmelding and Edward Schmelding.

West End Plumbing & Heating Co., Cleveland, O., capital $2,000. Among the incorporators is Albert J. Hall.

McGeorge & Cooper Mfg. Co., Oakland, Cal., capital $100,000, to manufacture gas heating appliances. Incorporators: W. C. McGeorge, C. D. and William Cooper, G. C. Gardner and W. A. Boston.

John J. Cahill Co., Chicago, capital $10,000, to conduct a heating and plumbing contracting business. Incorporators: J. J. Cahill, F. E. Cahill and I. N. Herreid.

Rose & Douglas Co., Ellenville, N. Y., capital $6,000, to engage in heating, plumbing and gas fitting. Directors: William C. Rose, William L. Douglas, both of Ellenville; and Richard T. Childs, East Orange, N. J.

Eastern Blower and Sheet Metal Works, Richmond, Va., capital $25,000. President, D. F. Harrington; vice-president, N. E. Reuter; secretary and treasurer, H. C. Hopkins.

Inland Supply Co., Danville, Ill., capital $35,000, to conduct a heating and plumbing business. Incorporators: H. C. Yelton, O. Finney and George Harroun.

Eastern Sanitary Mfg. Co., New York, capital $150,000, to manufacture and deal in heating and plumbing supplies. Incorporators: Arthur W. Shipman and Francis N. Dede, both of 200 Broadway, New York; and Arthur H. White, Passaic, N. J.

Sanitary Plumbing and Heating Co., Huntington, Ind., capital $[illegible].

Independent Plumbing & Heating Co., Oklahoma City, Okla., capital $4,000. Incorporators: J. B. Beach, H. F. Cooper and H. E. Ward, all of Oklahoma City.

National Plumbing & General Supply Co., 110 South 12th street, St. Louis, Mo., capital $100,000, to take over the business of the National Plumbing Supply Co., which failed recently. The company has also purchased the business of the Turner Supply Co., St. Louis. Among the incorporators are Fred G. Turner, George H. Robinson, Robert W. Moore, James R. Claiborne, William R. Scullin and [illegible], of St. Louis.

National Vacuum Washer Co., Los Angeles, Cal., capital $25,000. Incorporators: [illegible].

H. C. Williams Trap & Valve Co., Milwaukee, Wis., capital $[illegible]. Incorporators: H. C. Williams, H. L. Williams and [illegible].

Contracts Awarded

R. T. Ford, Rochester, N. Y., heating Building No. 8 at Exposition Park, Rochester, for $3,173.

Lane-Bowen Co., Lorain, O., heating and ventilating Lincoln and Lowell schools and high school building at Lorain. The [illegible] $[illegible].

Lewis & Kitchen, Kansas City, Mo., heating Prescott school, Kansas City, for $5,800. A hot-blast system will be installed, supplanting the present steam heating system.

Howe, Defendorf & Buruff, Rochester, N. Y., heating and ventilating Building No. 7 at Exposition Park for $[illegible].

Norris & Miller, Detroit, Mich., heating four barrack buildings at Fort Wayne Post.

Peters-Eichler Heating Co., St. Louis, Mo., contract for underground piping connection between Soldan High and Clark schools on Union avenue; also Central High School and Crow School at Grand avenue and School street. The contracts amount to $11,577.

O'Meara Heating Co., St. Louis, Mo., heating new school in [illegible] ventilating heating new school and ventilating new school buildings in the Bryan Hill district for $26,600. The plumbing contract went to the Edward Reisel Plumbing Co. at its bid of $10,377.

Gillis & Geogheghan, New York, steam equipment for the Capitol power house, at Albany, N. Y., and the steam and return connections between the power house, capitol and educational building. Contract amounts to $202,083.

Jennison Plumbing Co., Fitchburg, Mass., heating and ventilating addition to Priest street school at Leominster for $2,584.

Otto Biefeld & Co., Watertown, Wis., heating and ventilating Webster school in Watertown for $6,000.

Haynes-Kramer Co., Waukesha, Wis., heating and plumbing new $20,000 gymnasium and school building for St. John's Military Academy.

American Heating Co., Duluth, Minn., heating and plumbing new court house at Grand Marais, Minn., for $4,000.

Thomas Heating Co., Racine, Wis., heating and ventilating system in the Northern Michigan asylum at Traverse City, for $28,002.

Correcticn.—An item in this column in the July issue stating that the Huffman-Conklin Co., Columbus, O., was the low bidder for the heating and plumbing work for the General Hospital buildings in Cincinnati, is an error. We are informed by the architects for these buildings, Samuel Hannaford & Sons, Cincinnati, that the plumbing has been awarded in a general contract to the Westlake Construction Co., of St. Louis, which, in turn, has awarded same to another St. Louis firm. The heating contract has not yet been awarded.

Business Chances

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following-named work:

Until August 16, 1911, for the installation of a vacuum cleaning system in the new U. S. post office at New York.

Until August 16, 1911, for the construction, including plumbing, gas piping, heating apparatus, electer electric conduits and wiring and lighting fixtures of the U. S. post office at Massillon, O.

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THE HEATING AND VENTILATING MAGAZINE

1123 Broadway NEW YORK September, 1911

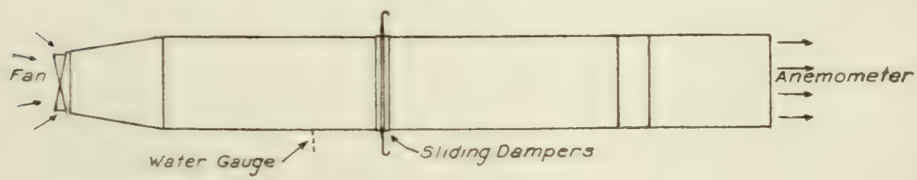
Characteristics of the Propeller Fan

The behavior of the propeller type of fan under varying conditions of speed and resistance was the subject of some noteworthy tests made by Oswald Stott, of Birmingham, England, which were reported in detail by him at the recent meeting of the Institution (British) of Heating and Ventilating Engineers. The tests were undertaken to determine primarily the amount of power utilized under these varying conditions, but the output was also noted.

The tests were all taken on the discharge side of the fan. Mr. Stott first made theoretical deductions as to the results likely to be observed at the discharge side, the intake or feed side of the fan being taken as unrestricted in any way.

The blades of a propeller fan, it was noted, are of the nature of a screw so that the traverse is doubled if the revolutions are doubled. As they are stationary, taken parallel with the shaft, the air is moved with a velocity depending upon the pitch of the blades and the efficiency of the design. Thus the velocity of the air moved by the blades should, apparently, be proportionate to the revolutions, and, therefore, to the volume. As to the power consumed, this may be proportionate to the revolutions or to some function of them, yet there may be no definite ratio. Using a well-known formula to ascertain the kinetic energy in the air moved, Mr. Stott showed that, theoretically, the power varies as the cube of the revolutions.

To present a clearer idea of the probable action of a propeller fan working against a resistance, Mr. Stott took as an analogy the ordinary parallel vise. The screw represents the fan, the movable jaw the air. When the jaws are open, we impart motion to it by turning the screw. The speed of the jaw depends upon the speed of rotation of the screw, so that the pressure produced at the screw appears as velocity of the jaw. When the jaw reaches the fixed partner, its forward movement is arrested and pressure reappears. The degree of pressure depends upon the force



ARRANGEMENT OF TEST DUCT

applied to the handle and may be sufficient to break the weakest part of the vise.

Taking any part of a fan blade, except the tips, it seems probable that the maximum pressure which that part is capable of maintaining will be the equivalent of the velocity of air, with free discharge, produced at that point. It may be less, but it is difficult to imagine it being more because, air being a liquid, there will be a release at that part immediately the pressure tends to rise beyond that maximum. This constitutes the "slip" which, as is well known, always occurs when a propeller fan is working against a resistance. As

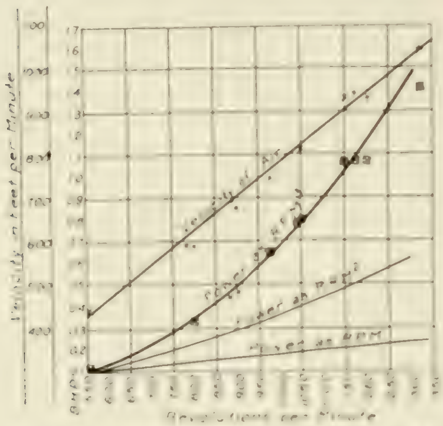


FIG. 1 RESULTS OF TEST WITH FREE DISCHARGE.

$$H = \frac{V^2}{2g}$$

apparently the static pressure (measure of resistance) will be proportionate to the square of the revolutions because the slip should be similarly proportionate. Mr. Stott noted that this theoretical characteristic, if correct, is less likely to be borne out by experiment owing to eddy currents in the fan.

The element of "slip," as Mr. Stott stated, is one of the principal points of difference in the operation of a propeller fan and a centrifugal fan, as the latter requires maximum power at free discharge.

Proceeding to a discussion of the results actually obtained by test, Mr. Stott stated that he used a propeller fan 24 in. in diameter over the tips, belt-driven by an electric motor. The fan was fixed upon a frame and discharged the air through a horizontal duct 36 in. x 36 in. x 25 ft. long. At a distance of 11 ft. from the fan, sliding dampers were inserted when required, to create a resistance to the passage of the air. By means of these dampers any desired resistance up to the maximum could be obtained. Shutting the dampers completely together completely blocked the outlet from the fan, except for a very slight leakage, thus preventing the passage of air almost entirely.

An anemometer was placed in the end of the duct opposite that occupied by the fan. As the area of this end of the duct was constant the air velocities only were obtained for comparison. To measure the created resistance a water gauge was used connected by a tube to the duct at a point about 2 ft. on the fan side of the dampers. A speed counter was used to measure the revolutions of the fan and 1-min. readings were taken.

As the primary object of the

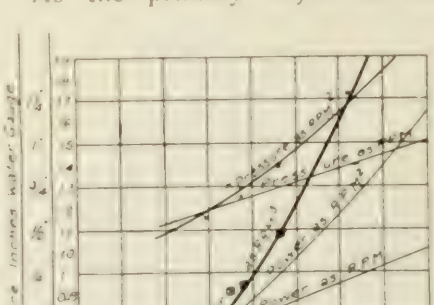


FIG. 2 RESULTS OF TEST WITH OUTLET ENTIRELY CLOSED

tests was to decide, if possible, the ratio of the power to the speed, considerable care was taken to have an accurately calibrated motor. One of 2 B. H. P. was used.

TESTS WITH FREE DISCHARGE

The first series of tests was taken with free discharge, the dampers being entirely removed. These tests showed that the air moved is proportionate to the revolutions of the fan. They also show conclusively that the power taken is proportionate to the cube of the revolutions. In the accompanying charts three power curves are given, the first being proportionate to the revolutions, the second to the square of the revolutions, and the third to the cube of the revolutions. The recorded tests follow the latter. Mr. Stott's paper contains detailed figures from which the charts were plotted.

The next series of tests was taken with the dampers fully closed and remaining in the same discharge and giving the maximum resistance. The resistance was measured as pressure and is given by the water gauge set up. It is found to be proportionate to the square of the revolutions. The

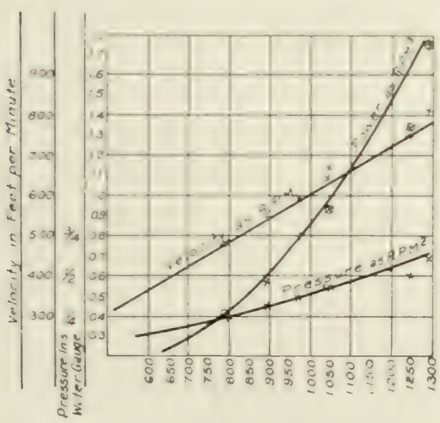


FIG. 3. RESULTS OF TEST WITH OUTLET PARTIALLY CLOSED

tests show that the power is proportionate to the cube of the revolutions.

The next series of tests was made with the dampers partially closed and remaining in the same position for every test, thus maintaining a constant "condition of resistance" for all speeds. Under these conditions the velocity of the air was found to be proportionate to the revolutions. The resistance was proportionate to the square of the revolutions and the power was proportionate to the cube of the revolutions.

Another series of tests, taken with the dampers more open, thus

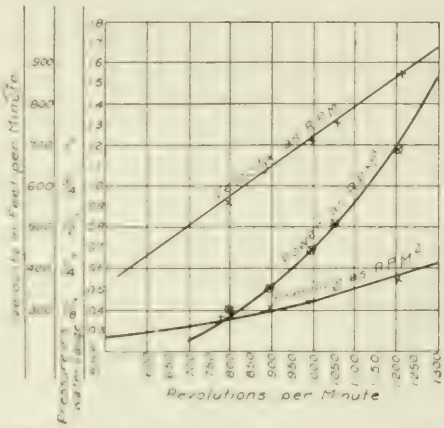


FIG. 4. RESULTS OF TEST WITH OUTLET PARTIALLY CLOSED

setting up less resistance, showed the same characteristics as the last record.

A fifth series of tests was taken as near a constant speed as possible, but with varying resistance obtained by moving the dampers nearer together for each succeeding test until fully closed. These tests showed clearly that the power rises to a considerable extent as the resistance is increased, following closely the theory of the characteristics of the propeller fan, as already outlined.

Commenting on the tests Mr. Stott points out that the manufacturers' statement that the power varies as the square of the speed does not take into account the difficiencies in efficiency of the motor, which are considerable. In the tests in question, for instance, the efficiencies varied from 25% to 75%. "I fancy," added Mr. Stott, "this is the rock upon which these makers may have been wrecked."

In one respect the tests do not support the theory that "the maximum pressure which that part is

capable of maintaining will be the equivalent of the velocity of air (with free discharge produced at that point." The tests show that the maximum pressure set up, at a given speed, is greater than the equivalent of the greatest velocity

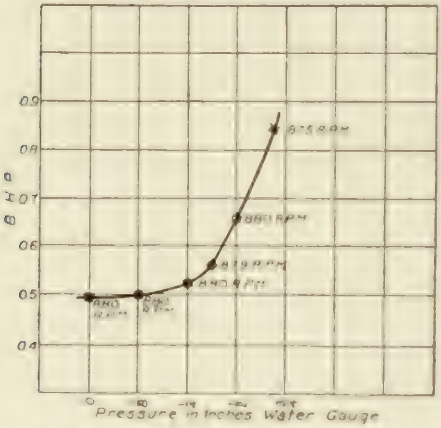


FIG. 5. RESULTS OF TEST WITH CONSTANT SPEED AND INCREASING RESISTANCE

of air at any point. Upon looking into this, Mr. Stott found that the velocities measured at different points of the fan from center to circumference are less than the forward traverse of the blade at that point. He also found that, with the particular fan tested, the maximum resistance registered (pressure set up), with the closed outlet, for a given speed, was the equivalent of the forward traverse of a part of the blade about 8¾ in. from the center, say on a circle 17½ in. diameter. It would take a special apparatus to decide this point, but it appears probable that, taking any given speed, the maximum pressures capable of being set up by various points of the blade from center to circumference will be the equivalents of the forward traverse of the blade at those points, and not the equivalent of the velocity of air measured at free discharge.

Another point noted by Mr. Stott is that when working against resistance there is, for a given speed, a point at which the mechanical efficiency is highest, just where, however, he was unable to say. It was not, as he had anticipated, at low resistance for the particular speed in question, but at a higher resistance.

Progress of Street Car Ventilation

Comments on present methods of street car ventilation, showing the growing interest in this subject, were made in a paper by W. Thorn, read at the recent summer meeting of the American Society of Heating and Ventilating Engineers, in Chicago. At the outset of his paper Mr. Thorn stated that the lack of attention given to this subject by street railway companies is not due to unwillingness on their part to provide proper ventilation for their cars, but is the result of a lack of thorough information and of ability to find practical apparatus or equipment for the purpose other than the usual means.

The problem of providing adequate ventilation in a street car, Mr. Thorn states, is not one easy of solution. The difficulties arise from several causes, among which may be mentioned the comparatively small capacity of a car body in which many people are carried, also the various desires and whims of passengers as to proper ventilation and the necessity for preventing drafts and chilling the air below the temperature required by the authorities.

The need for better ventilation than that afforded by the monitor or deck windows is much greater with modern pay-as-you-enter cars than with the double-end type of cars, which have both platforms open on one side to the air. This results from the fact that the front platform on the pay-as-you-enter cars is closed while on the other

cars it is open; therefore, the air cannot circulate so freely through the pay-as-you-enter car as through the double-entrance type when stops are made and the doors are opened to take on or discharge passengers.

To meet the need for better car ventilation several devices have been developed and are now on the market. The designers of some of these devices recognize that heating and ventilation should go together and have worked out their apparatus with this end in view. These ventilating devices or systems consist of two general types: first, those which depend upon the speed of the car for their operation. All such devices work on the aspirator principle. Second, are those systems which use mechanical means for circulation of the air and are practically independent of the speed of the car. Mechanical systems of both the exhauster and blower principle have been brought out.

Authorities differ as to the amount of air to be supplied per person per hour in order to provide adequate ventilation. An ordinance of the city of Chicago requires that in the ventilation of street cars not less than 350 cu. ft. of air per hour per passenger (based on maximum seated and standing load) shall be supplied; provided, however, that the carbon dioxide shall not exceed 10 parts in 10,000 parts of the air in the car. The 350 cu. ft. of air per hour per passenger shall be brought in through the openings or intakes provided for the purpose. There will also come into the car through cracks, crevices and the opening of doors a considerable volume of air. The ordinance further provides that the air for ventilation shall be brought into the car below the average level of the heads of the seated passengers and be taken out above the heads of the standing passengers, and that the intakes be so constructed as to exclude dust. It also provides that there shall be maintained within a car an average temperature not lower than 50° F.

There have been several ventilating systems tried out in Chicago, both the mechanical and automatic type, which are designed on the basis of the above outlined ordinance. Several hundred cars have been equipped with such ventilating systems.

(The author here gives a brief description of the Cooke car ventilating system, which was described at length, with illustrations, in THE HEATING AND VENTILATING MAGAZINE for April, 1910.)

The automatic systems installed are of several different kinds, but all depend upon aspirator action for their operation. One of these automatic systems, which has shown good results, comprises a number of "exhausters" located along each side of the monitor roof and attached to panels placed in the monitor or deck window openings. An opening in the panel communicates with the "exhauster." Intakes similar to those described in connection with the mechanical system are located in the floor and provide for a supply of fresh air. The "exhausters" are rectangular sheet metal boxes projecting outwardly from the panels to which they are secured, having openings top and bottom, and provided on the middle of each side face with V-shaped projections. The V projections are placed horizontally on the faces of the exhausters and "split" the air into two streams, one flowing upward and the other downward. The air streams flow past the openings of the exhauster and by induction "draw" the air out from the car.

The impression has generally prevailed that thorough ventilation could not be effected without increasing the amount of energy used for the heating of the car. Experience with the deck window method of ventilation in which the heating and ventilating systems are not closely related is undoubtedly responsible for this impression. Tests conducted on street cars with ven-

tilating systems, such as have been described, where the air in coming into the car passes first over the heating units and then is drawn up through the car and taken out at the top, demonstrate, however, that it is entirely possible to heat a car to substantially the same temperature with this system as when the deck window method is used, and with no greater expenditure of energy. We believe the reason for this lies in the greater efficiency of the heating units when working upon a continuous flow of fresh air passing over the heating surface as against the ordinary practice of placing the heating units in practically a dead air space where a considerable amount of the heating energy is lost in raising the temperature of surrounding parts of the car, such as the seats and the adjacent woodwork.

Tests made on both the mechanical and the so-called automatic systems show that it is possible to provide an air change in the cars about every three minutes, and this without the presence of objectionable drafts or the need of any more than the usual amount of energy for heating purposes.

In the light of experience with ventilating systems of the kind described, it can hardly be said that it is impossible to find practical means for the ventilation of a street car which will answer every reasonable requirement.

Features of the Reck Mixing System for Hot Water Heating

SAVING EFFECTED IN APPLYING THIS SYSTEM WHERE PUMPS ARE ELECTRICALLY DRIVEN

Many interesting points regarding the flow of hot water in pipes are brought out in a description of the Reck "Mixing" system, which was described at length by Capt. A. B. Reck, of Copenhagen, Denmark, at a recent meeting of the Institution (British) of Heating and Ventilating Engineers. The purpose of Capt. Reck's paper was to show the saving that could be effected by applying this system to hot water heating apparatus worked by electrically driven pumps. Capt. Reck presented four sketches (Figs. 1-4) giving an idea of the difference in the operation of a heating apparatus with and without the mixing system. In all the figures the horizontal pipe T represents the main flow pipe and the pipe U the main return pipe. The connections BF and BR between the mains and the risers are shown in Figs. 1 and 2 as ordinarily erected.

With these connections the cooled water which passes from the radiators and flows through the return risers LR finds no other passage further on than through the return main U that carries it to the boiler, from whence it returns to the radiators after having been reheated to the desired degree. Consequently, the temperature of the water as it enters the radiators will always be the same as the temperature in the boiler and in the flow main T, and if it is desired to diminish from a central point the temperature of the radiators by diminishing the temperature of the water in the flow risers, this can only be done by also diminishing the temperature of the water in the flow main T, as indicated in Fig. 2.

The Reck "Mixing" system consists in supplementing the ordinary pipe connections BF and BR by pipes through which, as may be desired, more or less of the water that has been cooled in the radiators can pass over and mix with the heated water that comes from the boiler through the pipes T and

BF. The pipes through which the water passes over are called the "mixing pipes," and will be found marked by the letter X in all the sketches (Figs. 1 and 2 excepted).

The action of these mixing pipes will easily be understood from Figs. 3 and 4, both of which show the same apparatus, only with the difference that in Fig. 3 the water must be imagined to have a greater velocity in the pipes T, U, BF and BR than in Fig. 4. If the motion of the water through the mains is caused by a pump, the velocity in the pumps may be varied by either altering the speed of the pump or simply by more or less throttling a valve V on one of the mains, as shown in Fig. 4.

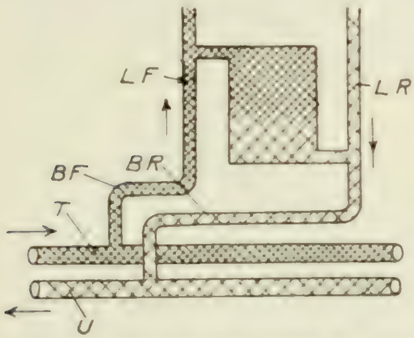


FIG. 1. ORDINARY HOT WATER HEATING SYSTEM SHOWING MAXIMUM YIELD AT RADIATOR

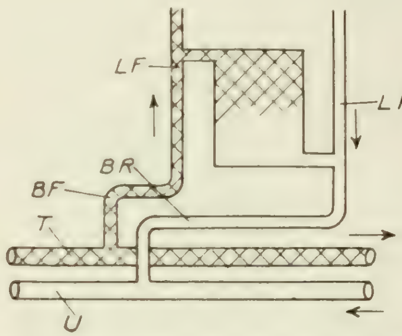
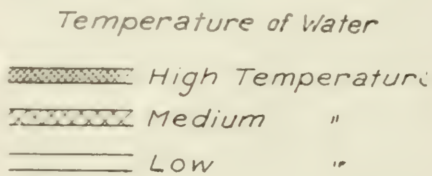


FIG. 2. ORDINARY HOT WATER HEATING SYSTEM, SHOWING MINIMUM YIELD AT RADIATOR



It will be seen that the mixing pipe X forms the link which completes the local circuit formed by the local flow riser LF, the radiators with their connecting pipes and the local return riser LR.

Suppose now that all the pipes in this local circuit are of such sizes that a quantity of water of the same temperature as the water in the horizontal flow main, and sufficient to heat the radiators to the desired degree, will pass through the pipes LF and LR only by the influence of the difference in temperature between the water in these pipes. Suppose, further, that the sizes of the branch pipes BF and BR, which connect the horizontal mains with the risers, are of such sizes that the same quantity of water, or, if not exactly so, then a little more, will pass through BF to LF when the pump that forces the water through the mains runs at its greatest speed and produces the greatest difference in pressure between the flow main T and the return main U, then Fig. 3 shows what will happen. All the water that has been cooled in the radiators will pass from the return riser LR through the branch pipe BR into the return main U. If the sizes of the branch pipes BF and BR happen to be taken exactly, the water in the pipe X will remain quite still, and only if the sizes of these pipes have been taken a little too large will a small quantity of hot water pass over from the pipe BF to the pipe BR through the pipe X. This, Capt. Reck stated, does no harm at all. In both cases the movement of the water through the risers LF and LR and through the radiators will be the same as in an apparatus according to Fig. 1, where the pipe X does not exist.

It is only when the speed of the pump is diminished, or when the valve V on the main is throttled

down that the action of the pipe X begins. In both cases, the supply of water to the riser LF from the pipe BF will at once become smaller than the quantity the riser is able to take, and what additional quantity it can take will come from the return riser LR through the mixing pipe X. Since the temperature of the water in the return riser is lower than the temperature of the water in the pipes BF and T, the result will be that the temperature of the water in the flow riser LF will be reduced more or less below the temperature in the flow main T.

How much the temperature is reduced in this manner depends only upon how much the speed of the pump is diminished, or how much the valve V is throttled down, and thus it will be seen that the Reck mixing pipes afford means for regulating from a central point of a hot water heating apparatus the temperature of the water that flows to the radiators through the flow risers by diminishing the quantity, but not the temperature, of the water that is forced out through the flow mains. Further, it will be seen that the peculiar feature of an apparatus with Reck mixing pipes inserted is that the difference in pressures created by the pump does not reach those parts of the apparatus which are beyond the mixing pipes. By the ordinary system, without mixing pipes, this is not so, and, therefore, not only the sizes of the mains but also the sizes of the risers and radiator-connections must be calculated from the difference in pressure created by the pump. But, if in an ordinary apparatus the speed of the pump is diminished, the difference in pressure it creates will be diminished also, and the result will be that the velocity of the water to the radiators on the lower floors of the building will be diminished much more than the velocity to the radiators on the upper floors, where the additional difference in pressure created by difference in temperature in the long risers is much greater than on the lower flowers.

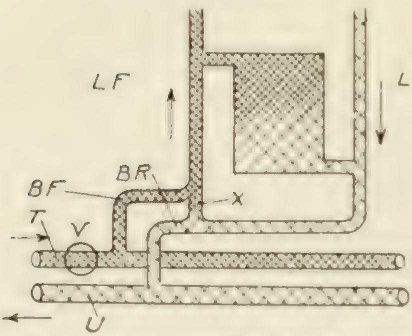


FIG. 2. ARRANGEMENT OF RECK MIXING SYSTEM, WITH VALVE V FULL OPEN, GIVING MAXIMUM YIELD

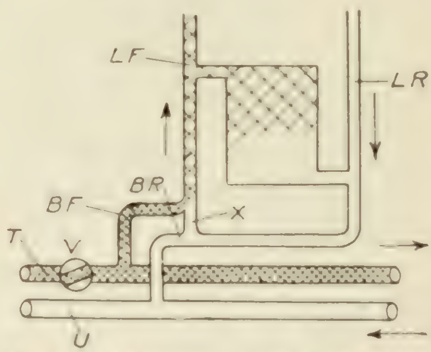


FIG. 3. ARRANGEMENT OF RECK MIXING SYSTEM, WITH VALVE V ONLY PARTLY OPEN, GIVING MINIMUM YIELD

Therefore, with the ordinary system, the only way to secure good distribution of heat between the different floors in a building is to let the speed of the pump be the same in mild weather and by night as in cold weather by day, whereas with the Reck "mixing" system at least nine-tenths of the time the pump has to run, its speed, as well as the power used, can be very much reduced.

Capt. Reck then presented an example, with illustrations, to prove these points, showing, from the results obtained that not only will the consumption of electric current be reduced, but a considerable saving will be effected in the first cost

of the heating apparatus, because the electric motor and the pump, as well as the sizes of all the mains, can be reduced to what is necessary for half the quantities of water. His paper also included illustrations of heating installations where several buildings, each with a number of radiators, are heated from a central plant. The illustrations included details of the piping.

In closing, Capt. Reck stated that in a school in Denmark, built four years ago, the valves on the radiators have never been touched by the occupants of the building. The handles of these valves were taken off and put in storage when the installation was completed and nobody has asked for the handles up to the present time.

Use of Steam Turbines in Heating Work

A paper presented at the recent summer meeting of the heating engineers, describing a central heating plant for two school buildings, presented by Samuel R. Lewis and published in THE HEATING AND VENTILATING MAGAZINE for August, mentioned the use of steam turbines in the power house, which, with other features, aroused an extended discussion, which was in part as follows:

PRESIDENT BOLTON: Here we have a description of an old plant which appears to bear the earmarks of success, so successfully remodeled that the new plant can be described in practically the same words as were used to describe the old remodeled plant.

I observe that the author has installed steam turbines in the school power house. I do not know why a turbine is desirable for such service, even with the explanation afforded by the author. The small steam turbo-generator is at present far from being a satisfactorily reliable apparatus. The speed at which it runs and the delicacy of the appliance require great care in its operation. In an office building in New York three steam turbo-generators have, on more than one occasion, become stalled when one machine would reverse another, driving it against steam with disastrous results.

The high speed at which turbines run produces, with a relatively small reduction in speed, a considerable drop in voltage. Consequently, a generator operating in parallel with another machine may lose voltage and become a motor driving its turbine against the flow of steam.

The subject includes the question of labor because with a machine of that kind you necessarily employ highly-paid engineers. For that reason, it has been desirable in my judgment to keep the character of all such apparatus as simple as possible, well within the knowledge and experience of the ordinary class of engineers who are likely to find employment in buildings.

Another feature in this plant is the use of a high tension of 250 volts on the electric service, which has nothing to do with the ventilating requirements excepting so far as to operate the motors at the very usual tension of 240 volts, but involves the use of the same high tension on the lighting system which would be extremely uneconomical.

MR. LEWIS: I might say that the electrical distribution there is simplified by the fact that very rarely, I suppose once or twice in a year, is it necessary to run both machines. The wiring is on a three-wire system, the light being at 110 volts and the higher voltage is used for power. The reason for that was a peculiar one. About eight or nine years ago I installed a plant at Galesburg, where I used a voltage of 110 volts. Three or four years later the board of education discovered that they were paying something like 8c. a kilowatt for the light in the other school. The city offered the board the free use of its poles if the board would run the wires from the other school plant, but they could not do it on account of the higher voltage.

Free Engineering

By George W. Knight and Perry West

Commenting on a practice that is not confined to any one branch of the engineering profession, but which is one, nevertheless, particularly characteristic of the heating trade the authors of the following paper, which was presented at the recent semi-annual meeting of the American Society of Heating and Ventilating Engineers, in Chicago, urge a stand which, it would seem, could be taken now by the profession, irrespective of the former necessity for such conditions as are described. Mr. Knight is the chief engineer for the Board of Education, of Newark, N. J., Mr. West being associated with him in this office. The principal portions of their paper are given herewith:

Free engineering does not mean what it literally expresses: namely, professional engineering services free of cost, but, as the subject of this paper, it refers to that portion of engineering work which is being furnished "apparently gratis" by certain manufacturers, contractors, etc.

The cause which has brought about the existing conditions where the engineer and the contractor are doing a large percentage of the engineering work, is based upon the old proposition of offering something for nothing. This proposition is alluring, and has proven quite effective, its effectiveness lying in the fact that the general public does not appreciate that this "nothing" really represents a percentage over the legitimate cost of apparatus or work, sufficient to maintain an engineering department for rendering this "something for nothing."

The evil effects of this practice are twofold, affecting chiefly the owner and the engineer. First, the owner, by either wittingly or unwittingly allowing the manufacturer or the contractor to perform his engineering services, increases the cost and reduces the quality of the work which he receives. The practical reasons for this are simple but conclusive. In order to render engineering services, the manufacturer and the contractor must add to the cost of their apparatus to the owner, in order to maintain engineering departments.

That the production cost of such engineering is high, as compared with that of the regular engineer's, needs no further argument than the fact that it is an intermittent side-line of work being carried on by those whose principal interests and qualifications are centered in their own particular line. That they are fully compensated for this work in proportion to its cost, is a simple, fundamental business proposition. That the services rendered are of an inferior quality naturally follows from the fact that the plans and specifications furnished must include a number of items such as pipe systems, duct systems, electric systems and other work, entirely outside of the manufacturer's and contractor's particular line, and upon which they cannot afford to expend the necessary talent and energies. It is folly to suppose for a moment that such plans and specifications are drawn so as to permit of fair competitive bidding, or that apparatus in which the manufacturer and contractor are particularly interested, will not be included, regardless of its adaptibility to the particular requirements; otherwise, who pays for the free engineering?

We intimate above that the owner maw act unwittingly in this matter, which means that his architect or agent may avail himself of this free engineering without the owner's knowledge, in which case the owner not only suffers all of the evil effects mentioned above, but pays besides an architect's fee on his engineering work equivalent to, or greater than, that necessary to employ a competent engineer. This should be plain enough to hard-headed business men, and to us engineers who know the cost of producing proper plans and specifications, is it too plain.

The owner may say very honestly that the quality of the work which he is receiving is satisfactory, but we believe that he is led to say this through his ignorance of what a better quality of equipment would really mean to the success of his undertakings. We feel that, on the whole, engineering work has risen to a comparatively high plane, especially within the last decade. We mean by this that the equipment of to-day is far superior to what we have been accustomed to in the past. This, however, may be said of the equipment of the past as compared with older and more antiquated work.

The degree of perfection in the attainments in this line, as in all other lines, is too apt to be measured by the layman in comparison with something inferior, instead of trying to measure by the best attainable.

As the representative body of equipment engineers, we are largely responsible for the perfection of attainment in our own lines. If we are not, then we are not endeavoring to perform our duty, or we are not equal to our task. In such a position, it is our duty to inquire as to how well our work is being done, and to develop such ideas as will best advance the interests of this work and our profession. In the first place, it is necessary, in order that any work be done well, that it be in the hands of unbiased, unrestricted, competent men. The supply of men who would measure up to this standard, we believe to be ample for all requirements, but in order to develop, protect and preserve such men, it is necessary that they secure the work and the compensation.

Second, the engineer is being deprived of a large portion of business, and in a great many instances is forced to reduce his legitimate fee for professional services, in order to secure some of the business that is being done "apparently gratis" by others. In addition, the reputation of engineering work in general is reflected upon, to its own discredit, by this character of work. The engineer is placed, in this connection, in much the same position as would be occupied by the doctor if the druggist should maintain a free physician's service by charging enough for his drugs to maintain the same, or as would be occupied by the manufacturer and contractor themselves, should the engineer manufacture and furnish free apparatus by charging enough for the engineering to cover the cost of these items.

The authors have discussed this subject very freely with many manufacturers and contractors, and are convinced that probably 50% of them are willing, yes, even anxious, to abandon the practice, provided the remaining 50% would do the same. They frankly admit the practice to be wrong, and harmful to the engineering profession, but they state that it is necessary for them to continue it in order to secure the business, for the reason that if they are called upon by an owner or architect to draw heating and ventilating plans and specifications, and refuse to do so, some one else will, and so secure the business. And here is where the engineers, by a little concerted action, could bring the remaining 50% into line.

Take, for example, the comparison referred to above, between the physician and the druggist, and the manufacturer and the contractor, and the engineer. How many physicians would recommend their patients to such a druggist for their medicines? Or how many manufacturers and contractors would recommend such an engineer?

In this connection, legislation would accomplish a great deal toward breaking up the practice of "free engineering." There does not seem to be any reason why engineers should not be registered, as are physicians and architects. Surely their field is of sufficient importance, and in a great many instances the lives of many persons are dependent upon an absolutely correct engineering design.

DISCUSSION

President Bolton:—I recall this matter being brought before this society a number of years ago and exciting at that time quite a degree of attention. Some years ago one of

our college buildings in New York City required to be equipped with a heating and ventilating plant. The architect was a man for whom I had previously done some work and I naturally applied to him for an opportunity of designing this plant. He led me to his drafting room and showed me nine sets of plans which had been prepared by different contracting firms for various schemes of heating and ventilating that building. I roughly estimated the actual cost of each set of plans to be $160.00 for drafting services and, if overhead charges were added, I should say about $300.00 apiece would be the actual cost, making a total of $2,700 which the heating and ventilating contractors paid out to produce plans for one installation, only one of whom could possibly get it.

Inquiring further into the practice you will find it extends into other kinds of work such as, for instance, steel construction. One steel company employs a force of 100 draftsmen upon the details of steel frames for buildings only. A consulting engineer in New York told me that he had to draw plans for steel framing for buildings for 1% or he could not get the work.

Another professional engineer engaged in the same line is only able to make good and even his fees by taking the contractor's or manufacturer's plans and cutting down the amount of metal to the narrowest limits within the regulations of the Department.

It seems to me increasingly necessary for the manufacturers and engineers in the difficult branches of our profession to put our heads together and insist upon payment for plans and advice. Some of our fellow members in Philadelphia have already insisted on payment of 2½% on their figured cost for the plans and specifications which they prepared and I understand they have had no difficulty in securing payment.

I would not favor legislation as a remedy for this condition and I do not think there is much to hope for in the proposed licensing of engineers. We shall gain more in the end by simply bringing this question forward for discussion and ventilation.

Mr. Bronaugh: It appears to me that the matter requires principally a campaign of education, because the manufacturers would be the first ones to grasp at an opportunity of getting away from the practice.

Mr. J. H. Davis: Speaking from the manufacturers' side, my observation is that it would be very difficult for the manufacturer to introduce any new system or anything of a similar character without making plans. The engineer, the architect or the master fitter will say, "How do we know that this is any good? You have got to guarantee it. Nobody knows anything about it. The only way for you to do is to give us plans and specifications and we will take our figures from them." I think that our president knows from his own experience how hard it was to have the best engineers recognize the principles of vacuum system heating until the responsibility of their operation was taken up by the manufacturers themselves. Recently, my observation of the blower system work is very much the same. The entire heating profession relies more or less on the blower companies for information and takes from them their guarantees and they have the blower companies make their layouts. Without that procedure the blower business would never have grown as it has.

I know from the manufacturers' side that they would be glad to get rid of this engineering expense. As soon as the architects ask enough commission or fees to hire capable engineers, they will do their own engineering, and the manufacturer will be glad to be rid of all engineering.

Mr. W. M. Mackay: Some manufacturers look upon the making of plans as an advertising expense, claiming that they gain more business by

properly designing and specifying their apparatus so that they can insure its perfect operation when properly installed. Consequently it seems to me this is something which will gradually work itself out.

PROF. HOFFMAN: I think we will all agree that the paper has the right trend, but I believe when it comes to legislation, or anything like that, we must rather undertake, as has been said, a campaign of education.

Vibration Caused by Ventilating Fans

Some ideas on the cause and cure of vibration from ventilating fans were brought out at the recent meeting of the heating engineers in Chicago. Prof. J. D. Hoffman, referring to a heating plant described by S. R. Lewis, opened the discussion:

PROF. HOFFMAN: I would like to inquire how the ventilating fans in the attic were supported without having the vibration from the fans affect the building or be noticed in the building. In one or two cases, I have noticed that ventilating fans placed in the attic were noticeably noisy or jarring, and the vibration was felt down through the other rooms.

MR. LEWIS: In the fireproof construction buildings, the fans are set on wooden timbers of yellow pine. There is no vibration in that building. But in the old building, the fans are supported on the main bearing wall, the fans being comparatively small. I think the fan in the old building has a 24-in. wheel. We have had no trouble from the fans when we supported them on the bearing wall all the way through.

I might speak of one experience I had in Chicago. We had a ventilated school building heated by direct radiation. The only place we could locate a fan was in the attic. We found that the main brick wall stopped at the ceiling of the first floor. We got next to the old walls and put down three large steel columns clear to the bottom beams, ran them to the attic and constructed on that steel platform the fans and motors. If the building should ever burn down that wall will remain standing there.

PROF. HOFFMAN: The reason I asked that question was that in one case I know of, a building was fitted at the center with heavy masonry walls from the foundation and the attic fans were set upon these walls. Yet the vibration was noticeable around the building and there was some noise to be detected in the various rooms.

MR. LEWIS: I do not think that would have happened if the fan and motors had been properly balanced and the speed not too high. I have a good deal of experience with attic fans and motors and have never had any serious trouble. I think once or twice we have had noise and have cured it by making the manufacturer give us a better-balanced fan.

MR. A. C. BURDICK: I was called in one time in connection with a church heating plant, where the fan was placed in the church tower on about the level of the ceiling. In that case the fan was set on a wooden floor with wooden joists, in practically a drum. By using a heavy thickness of felt and connecting the fan to the duct with heavy canvas and the motor set on heavy felt, the motor made more noise than the fan did. In fact, the motor made a noise that was heard in the building.

PRESIDENT BOLTON: I have supported fans on spring connections by placing the fan and framing on light I-beams extending from a wall to the top of the nearest column and have succeeded in operating large fans on the roofs of hotels in this manner without giving trouble on the floor below, the spring afforded by the beams taking out any vibratory effect on the building.

Heating and Ventilating a Large City Residence

INDIRECT HOT WATER HEATING SYSTEM, COUPLED WITH EXHAUST FAN, IN RESIDENCE OF WHITELAW REID, NEW YORK

See Pages 34-35 for General Layout of Heating System

The New York home of Whitelaw Reid, United States Ambassador to England, is the south portion of a pretentious four-story and basement building which combines in one structure three separate residences. The building is located at the northwest corner of Madison avenue and Fiftieth street, New York, each residence having a main entrance opening into a common courtyard. The building is constructed with a central portion and two wings; the southern wing is Mr. Reid's residence.

With the exception of a seven-story extension on the Fiftieth street façade, the building is not a new one, and has been heated for years by means of an indirect steam heating system. When the question of heating apparatus for the seven-story extension was discussed, a hot water system was decided upon, despite the height of the extension. At the same time it was decided to remove the steam heating apparatus from the old portion of the residence and provide in its place a thoroughly modern hot water heating plant.

Within the past year the new heating system has been installed. In addition a system of ventilation has been put in for the music room, kitchen and interior store rooms, toilets, etc. The arrangement includes vent flues which are carried to the attic where they are connected to an exhaust fan, driven by a direct-connected electric motor.

Owing to the unusual shape of this residence, having three exposed sides, it was possible to locate four fresh-air intakes on its three sides so that sufficient air supply is obtained, irrespective of the direction of the wind. The plant as installed contains a number of unusual features, not the least noteworthy of which is the use of steam delivered through the mains of the New York Steam Co., which, after being reduced to about 5 lbs. pressure, is connected to the two convertors which furnish the hot water supply for the heating system. High pressure steam is supplied to the steam coils for the laundry dryers and also for the two hot water tanks for the plumbing system.

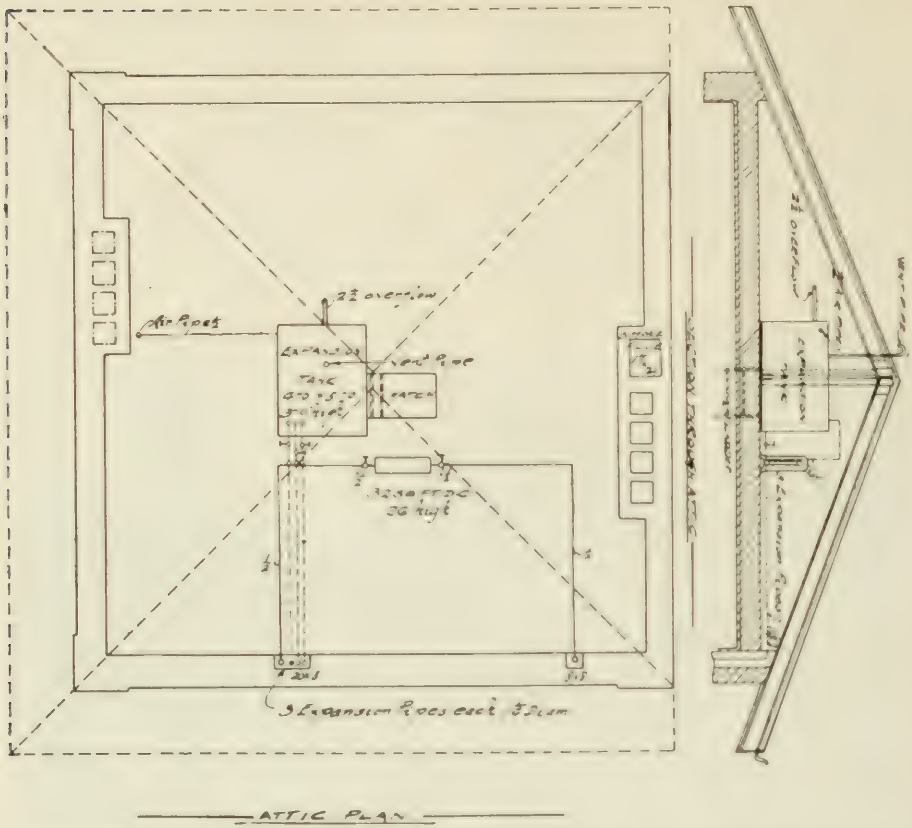
The general arrangement of the heating system, unusually complete for a building of this character, may be seen from the accompanying plans. An Ideal sectional cast-iron hot water boiler is installed for emergency use. The hot water convertors are installed in duplicate, one being of sufficient capacity to supply the entire heating needs of the enlarged residence. These convertors are of the

FIFTIETH STREET SIDE OF RESIDENCE OF WHITELAW REID, FROM VIEW TAKEN DURING ALTERATIONS

Goubert feed-water type. Each convertor contains 233 sq. ft. of heating surface, consisting of 90 $1\frac{1}{4}$-in. seamless drawn brass tubes expanded at the ends into steel tube sheets. The shells and water chambers are of heavy cast-iron and are provided with large outlet for large flow and return mains. The shell of each convertor is 25 in. in diameter and the tubes are $96\frac{7}{8}$ in. long. The convertors are supported on cast-iron saddles and rest on brick foundations.

Steam enters the building through the main of the New York Steam Co. It is then passed through a 4-in. x 6-in. Kieley pressure reducing valve, provided with a by-pass and three valves, and flows thence to the convertors. The water of condensation is discharged through a 4-in. Utility chronometer valve to a No. 3 Utility

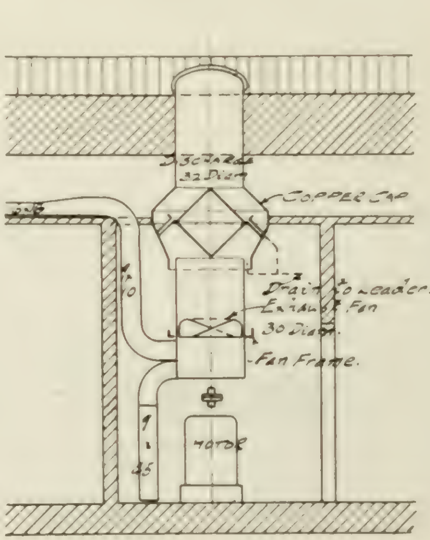
RESIDENCE OF WHITELAW REID AT MADISON AVENUE AND FIFTIETH STREET, NEW YORK



PLAN OF ATTIC, WHITELAW REID RESIDENCE, SHOWING EXPANSION TANK AND CONNECTIONS

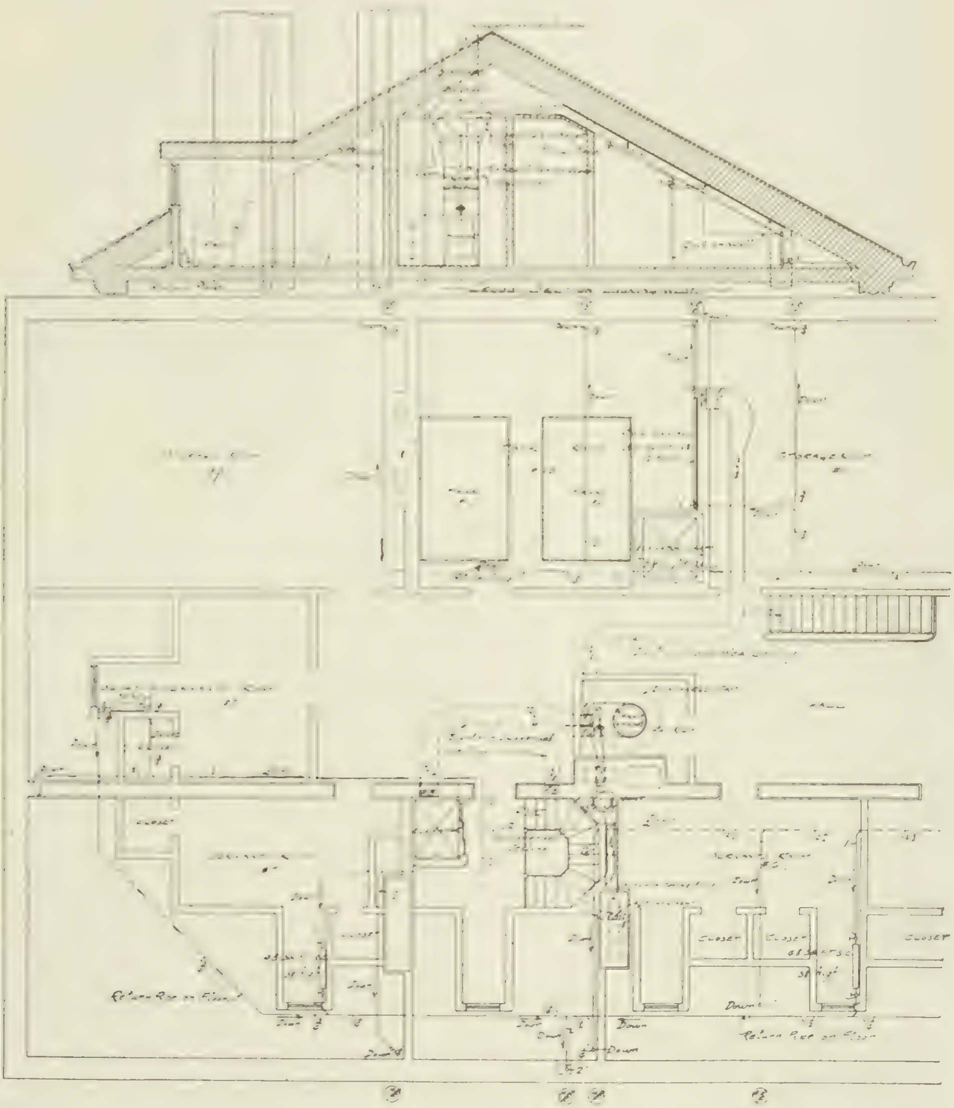
pump governor, thus maintaining a sealed water level. The water condensation is then passed through a cooling coil to reduce its temperature to the proper point before it passes to the sewer. The cooling coil is made up of two 4-row sections, each 8 ft. long and 3 ft. wide and is of the Sturtevant St. Louis type. The coil is provided with a by-pass and three valves. Through this cooling coil is also passed the water of condensation from the laundry dryers and the hot water boilers of the plumbing system. Contrary to usual methods, the New York Steam Co. supplied, instead of its usual St. Johns steam meter, a water meter for measuring the rate of condensation.

From the boiler and from each convertor are run three 1¼-in. expansion lines independent of each other and



DETAIL OF EXHAUST FAN, WHITELAW REID RESIDENCE

connected to the expansion tank in the attic of the new building. The expansion tank is 4 ft. wide by 5 ft. long by 3 ft. high and is provided with a 2½-in. overflow pipe connected to the nearest leader and a ½-in. signal pipe as indicated on the cellar plan. The air passes through cheese cloth filters and thence, through cold-air ducts, to the indirect heating stacks. All fresh-air chambers are connected together with galvanized iron ducts, so that the



PART PLAN OF FIFTH FLOOR, WHITELAW REID RESIDENCE, SHOWING VENT DUCTS AND EXHAUST FAN

down to the cellar. It is provided with an automatically controlled cold water connection and a vent pipe.

INDIRECT HEATING SYSTEM

The indirect heating system is connected to four fresh-air inlets, located

supply of fresh air is independent of the direction of the wind.

The indirect heating stacks are made up of Vento indirect radiators spaced 4 in. on centers and are suspended from the ceiling. All of the

rooms are supplied with indirect heat except the servants' bedrooms, which have direct radiators of the Peerless pattern, sectional type, with threaded nipples.

The Johnson system of temperature regulation is installed in connection with the indirect heating apparatus. There are 32 thermostats controlling 37 heat sources. Among these are two hot water thermostats controlling the steam and return valves for the hot water convertor so that the water in the heating system can be maintained at any desired temperature between 100° F. and 200° F. One hot water thermostat controls the damper in the smoke connection and ash-pit door of the hot water boiler. The indirect heating stacks are controlled by diaphragm dampers in the hot-air connections leading to the rooms to be heated.

The kitchen and various rooms in the basement, as well as the interior toilets on the other floors, are provided with exhaust flues which are carried to the attic in the old building. Here they are connected to a 30-in. Blackman fan, with direct-connected electric motor, and having a copper discharge cap arranged as shown in the sectional view.

At the ceiling of the music room is an ornamental rosette with openings which are connected with an exhaust duct leading to the attic whence the vitiated air is discharged through a copper discharge cap.

The architects are Messrs. McKim, Mead & White, New York. Messrs. Nygren, Tenney & Ohmes, consulting engineers, New York, designed the above-described apparatus and superintended its installation. The contractors for the work are Baker, Smith & Co., New York.

Future Use of Soft Coal in New York

Discussing the subject of smoke prevention at the recent meeting of the heating engineers in Chicago, President R. P. Bolton said that the time is rapidly approaching when New Yorkers will be compelled to make use of soft coal.

The price of hard coal, he said, has been advanced this season 25 cents a short ton on all the smaller and cheaper grades and it is expected that each year will see an equal increase in price which will soon bring the cost of hard coal to such a high figure that it will be necessary to burn, first, mixtures with soft coal and, finally, soft coal altogether, as the card coal supply gradually gives out.

"It is not too much to say," continued Mr. Bolton, "that there is not one boiler in one hundred in New York City that is set in the proper manner so as to make proper use of the mixtures of hard and soft coal, let alone the exclusive use of soft coal. So that the conditions of things in New York will eventually be serious and will have to be dealt with in the not very distant future.

"The great trouble I have noticed in connection with such boilers as do use soft coal in New York is that the boilers are all set too low, a condition that is very common, and one which frequently leads to disastrous results. A boiler set too low upon the furnace reduces the furnace temperature and, in the case of water tube boilers, the inclination of the tubes brings the comparatively cold tube surfaces against the gases that are being distilled at the rear part of the furnace, chilling the gases and preventing their combustion.

"An instance in point is the experience gained in connection with the water tube type used for marine purposes. The Plant Line steamship La Grande Duchesse was originally equipped with water tube boilers of the Babcock & Wilcox type, the tubes being inclined from the front to the rear of the furnace in the then usual manner. It hap-

pened to fall to my lot to find out what was the trouble with the boilers, which brought about a great waste of fuel and emission of smoke and even of flames, the vessel having been seen in New York harbor with flame reaching 20 feet high above the stack. After observations, I made the suggestion that the boilers either be raised 1½ ft. or turned around end to end. The latter course was eventually followed with this type of marine boiler and now thousands of horsepower are in use and are very good smoke-consuming devices.

"In connection with the same general subject I have been interested in comparing the amount of light provided by nature and the amount of artificial light used in its absence. My observations of a number of buildings have shown that as the intensity of light varies, so the use of electric light varies. In making similar inquiries in Chicago I found that the intensity of sunlight varies very much from that in New York, the sunlight in the early morning as compared to that of New York City being less in degree. I found that this lack of light corresponded with a large amount of electric lighting, evidently used to make up for the limited degree of sunlight. The Weather Bureau informed me that this deficiency of sunlight was due to the pall of smoke gathered over the city during the night, which would continue to hang over the city during the early business hours of the day, or until some breeze had blown it away. So you will see that we pay directly for the production of smoke by an additional use of electric light."

Mr. Bird: I have estimated that there are about 10,000,000 tons of coal burned each year in the city limits of Chicago. Mr. Bolton figures that the corresponding figures for New York City are 17,000,000. Per capita, the figures for Chicago are a little higher, but I believe both figures are right in spite of that. Within the city limits of Chicago there is probably more manufacturing proportionately than in New York. So I think we do use more coal per capita in Chicago than in New York. The coal used in Chicago also may be of less thermal value per ton.

Our estimate of the coal consumption was made for the purpose of deciding where the smoke came from that is made in Chicago. We divided all the users of coal into seven classes and then we made thousands of observations of the density of smoke made by the plants in these various classes. With those data, together with the total coal consumption in each class, we were able to compute the amount of smoke made by each class. The results showed that the railroads in Chicago make 43% of the total smoke produced in the city. That seems like a generous proportion because they burn only 18½% of the coal consumed. Of course, our railroad situation is quite different from that of New York City. Here we have over 30 different railroads operating in Chicago. We have about 25 trunk lines, besides a number of transfer or belt lines. They are operating about 1,500 locomotives all the time in the city over about 2,200 miles of track.

The next largest producers of smoke in Chicago are the miscellaneous power plants, which include high-pressure plants such as factories, mills and all stationary power plants that are making steam for use as power. The third largest smoke producers are the special furnaces, like those in our steel mills, the reheating furnaces and the terra cotta plants and brick yards and all plants that burn coal for making heat that is not used in connection with steam power.

The fourth largest smoke producers are the heating plants in the central district. The river craft make 4%. The coal used in flats and for domestic heating makes only about 4½%. This figure refers to

plants used primarily for heating homes and apartment houses. This percentage is surprisingly small, but the smoke they make is more objectionable than the smoke made by the large factories, because it is emitted a relatively short distance from the ground and in the residence neighborhoods. The amount of coal used in domestic heating is about 15%. That refers strictly to homes.

Ohio's New Building Code

COMPULSORY VENTILATION REQUIRED IN THEATRES AND ASSEMBLY HALLS AND IN ALL SCHOOL BUILDINGS, PUBLIC AND PRIVATE

A new building code for the State of Ohio, passed May 31 last and approved by Governor Harmon June 14, is a lengthy and impressive document, regulating the construction, etc., of public and other buildings, including theatres and assembly halls, churches, school buildings, asylums, hospitals and homes, hotels, lodging houses, apartments and tenement houses, and club and lodge buildings. Special sections contain regulations for the sanitary condition of such buildings and under these sections provision is made for the mechanical ventilation of all theatres, assembly halls and school buildings in the state. The provisions relating to theatres and assembly halls are as follows:

THEATRES AND ASSEMBLY HALLS

A heating system shall be installed which will uniformly heat all parts of the building to a temperature of 65° F. in zero weather.

All parlors, retiring, toilet and check rooms, and all assembly halls used in connection with and a necessary adjunct to a church, school building, lodge building, club house, hospital or hotel shall be heated by an indirect system combined with a system of ventilation which will change the air not less than six times per hour. All other assembly halls and theatre auditoriums shall be heated and ventilated by a system which will supply to each auditor not less than 1,200 cu. ft. of air.

The system to be installed where a change of air is required shall be either a gravity or mechanical furnace system, gravity indirect steam or hot water, or a mechanical indirect steam or hot water system.

No stove or open grate shall be used in any theatre or assembly hall, except water heaters, furnaces and boilers.

No stove pipe shall be more than 5 ft. long, measuring horizontally, unless the same be enclosed in a standard fireproof heater room, nor shall any stove pipe come closer to any combustible material or ceiling than 3 ft.

The fresh air supply shall be taken from outside the building and no vitiated air shall be reheated. The vitiated air shall be conducted through flues or ducts to and be discharged above the roof of the building.

No floor register for heating or ventilating shall be placed in any aisle or passageway.

No coil or radiator shall be placed in any aisle or passageway used as an exit, but said coils and radiators may be placed in recesses formed in the wall or partitions providing no part of the radiator or coil projects beyond the wall line.

In this connection, it is stipulated that in the case of moving-picture shows, the booth in which the motion machine is located shall have an opening not less than 10 in. in diameter for ventilating, which shall be flanged to carry a standard conductor pipe for exhausting the hot air generated in operating the machine. Connection shall be made with chimney or the outer air. Conductor pipe shall be riveted together, and outer end arranged so that escaping gases or flames will not come in contact with combustible material.

SCHOOL BUILDINGS

The provisions for the heating and ventilation of school buildings are almost as explicit. They are as follows:

A heating system shall be installed which will uniformly heat all corridors, hallways, play rooms, toilet rooms, recreation rooms, assembly rooms, gymnasiums and manual training rooms to a uniform temperature of 65° F. in zero weather; and will uniformly heat all other parts of the building to 70° F. in zero weather. An exception is made in the case of rooms with one or more open sides used for open air or outdoor treatment.

The heating system shall be combined with a system of ventilation which will change the air in all parts of the building except the corridors, halls and storage closets not less than six times per hour.

The heating system to be installed where a change of air is required, shall be either standard ventilating stoves, gravity or mechanical furnaces, gravity indirect steam or hot water; or a

mechanical indirect steam or hot water system.

Where wardrobes are not separated from the class room they shall be considered as part of the class room and the vent register shall be placed in the wardrobe.

These wardrobes are separated from the class rooms, they shall be separately heated and ventilated the same as the class rooms.

The bottom of warm air registers shall be placed not less than 8 ft. above the floor line, except foot warmers which may be placed in the floors of the main corridors or lobbies.

Vent registers shall be placed not more than 2 in. above the floor line.

The fresh air supply shall be taken from the outside of the building and no vitiated air shall be reheated. The vitiated air shall be conducted through flues or ducts and be discharged above the roof of the building.

A hood shall be placed over each and every stove in the domestic science room, over each and every compartment desk or demonstration table in the chemical laboratories and chemical laboratory lecture rooms, of such a size as to receive and carry off all offensive odors, fumes and gases.

These ducts shall be connected to vertical ventilating flues placed in the walls and shall be independent of the room ventilation as previously provided for.

Where electric current is available, electric exhaust fans shall be placed in the ducts or flues from the stove fixtures in domestic science rooms and chemical laboratories, and where electric current is not available and a steam or hot-water system is used, the main vertical flues from the above ducts shall be provided with accelerating coils of proper size to create sucient draft to carry away all fumes and offensive odors.

The code applies not only to public school buildings, but to all parochial and private schools, colleges, academies, seminaries, libraries, museums and art galleries, including all building or structures containing one or more rooms used for the assembling of persons for the purpose of acquiring knowledge or for mental training.

The enforcement of the new law, as regards its heating and ventilating provisions, is placed in the hands of the chief inspector of workshops and factories or building inspector, or commissioner of buildings in municipalities having building departments.

Failure to obey the provisions of the act or any order of such officers is made a misdemeanor and conviction will entail a fine of not more than $1,000. Any architect, engineer or contractor violating or assisting in the violation of any of the provisions of the act is subject to similar punishment.

New Building Trades Association in Chicago

A new central body in the building trades of Chicago, known as the Associated Building Trades, has been formed to take the place of the Building Trades Council, as the result of the factional fight between the plumbers and steamfitters of that city. In this fight certain unions in the Building Trades Council which have aligned themselves on the side of the steamfitters have now withdrawn and have formed the new organization. Peter Shaughnessy, president of the Bricklayers' and Stonemasons' Union, has been elected president.

The unions, with their membership, in the new council are:

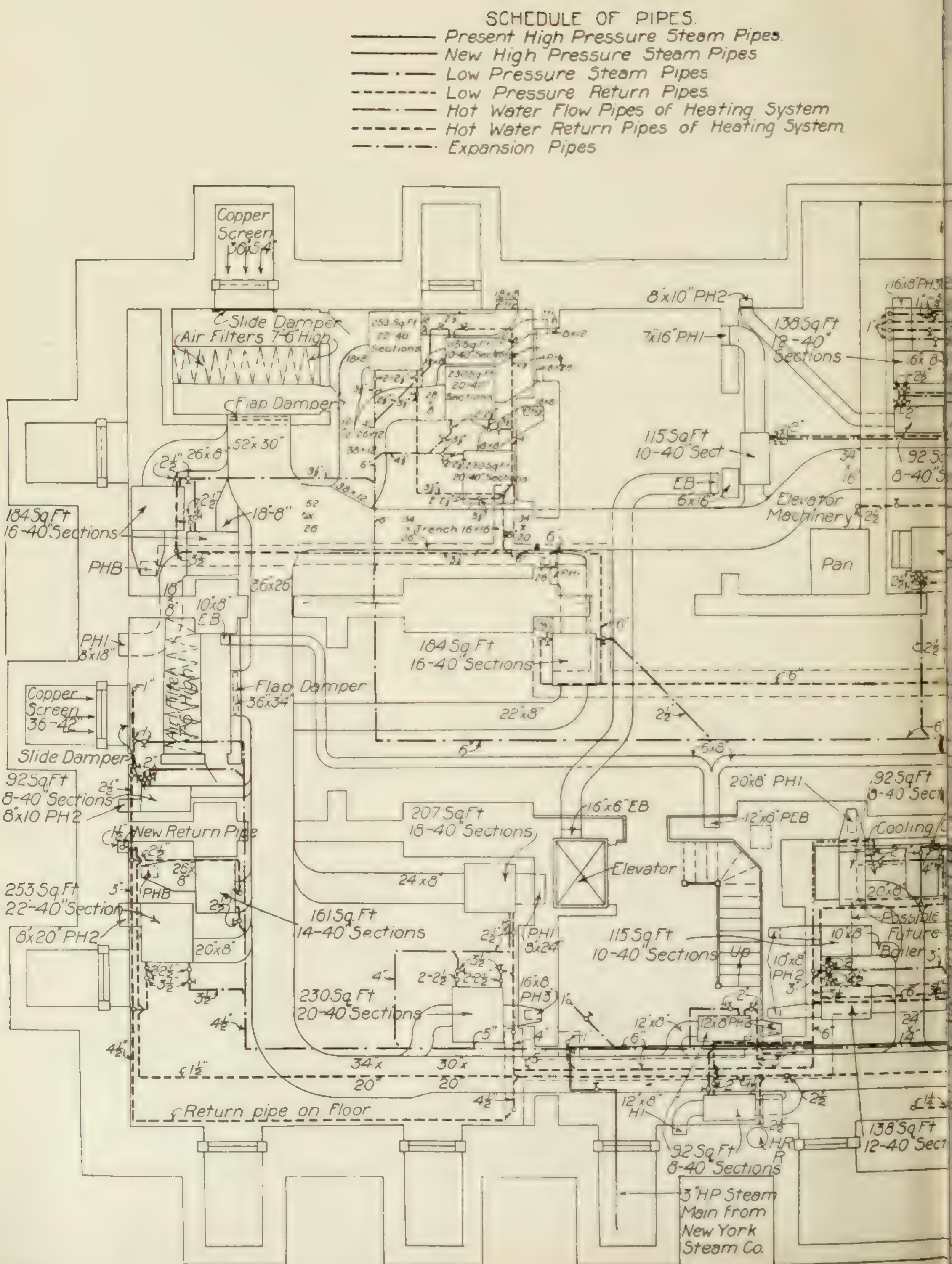
Boilermakers	250
Boilermakers' helpers	250
Bricklayers and stonemasons	8,000
Carpenters	17,500
Hoisting engineers	250
Glassworkers	400
Glaziers	500
Lathers	600
Mosaic workers	300
Mosaic workers' helpers	300
Plasterers	1,700
Roofers and helpers	400
Tile layers and helpers	150
Building laborers	17,000
Steamfitters	650
Junior steamfitters	650
Total	49,900

Besides the organizations in the new central body, the following are either sympathizing with its purposes or remaining neutral:

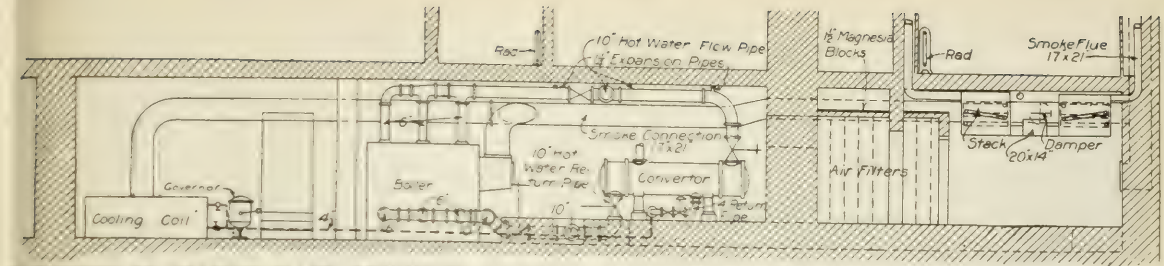
Painters	10,000
Structural iron workers	900
Marble cutters and setters	400
Other trades	6,000
Total	17,300

The unions remaining in the old council and which are friendly to the plumbers are the sheet metal workers, machinists and electricians.

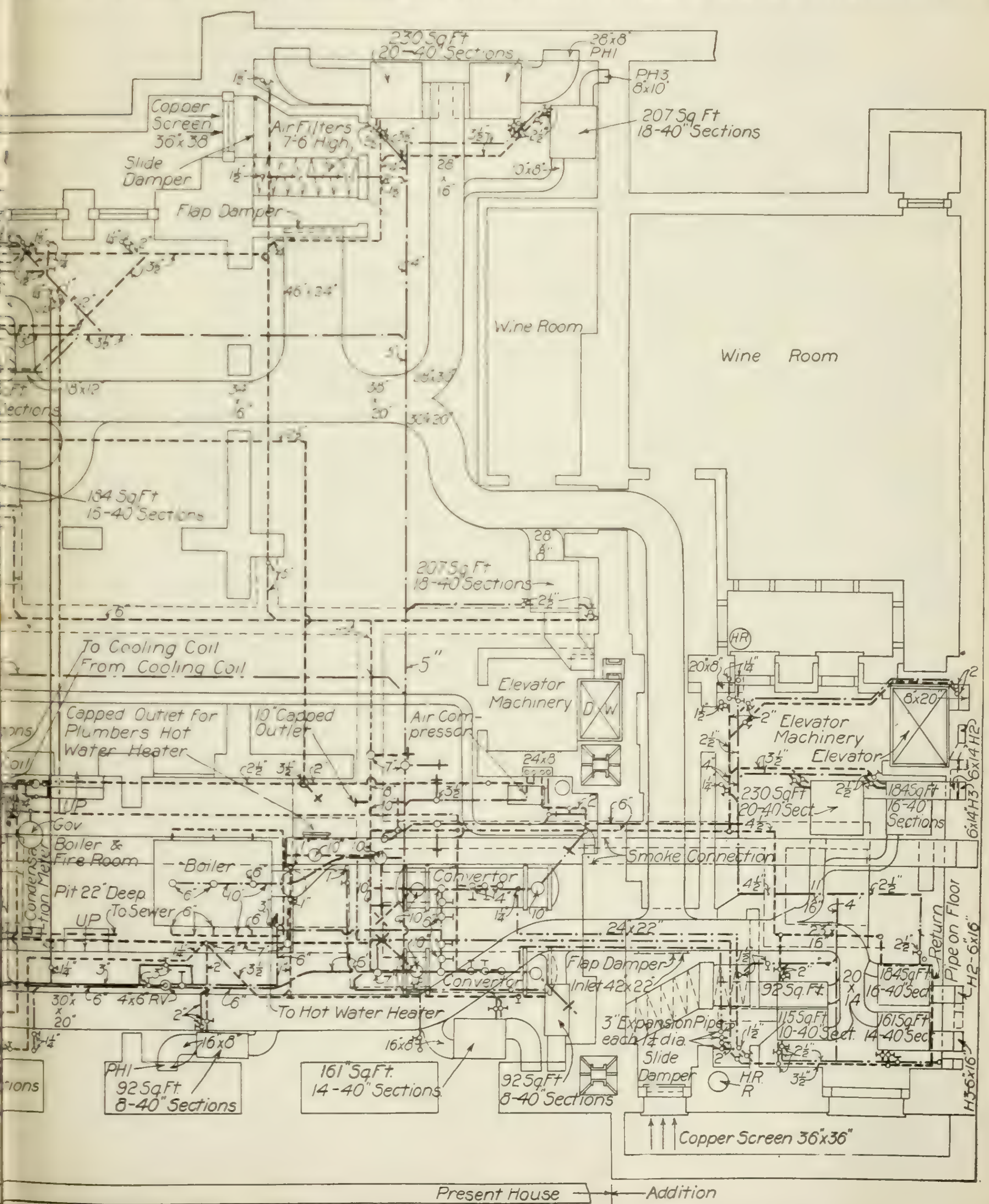
As already outlined in these columns the factional fight between the plumbers and steam fitters of Chicago arose through an effort on the part of the United Association of Plumbers to enlarge their organization to embrace the local steam fitters. Upon the refusal of the steam fitters as a body to amalgamate with the plumbers, the latter organized a steam fitters' union of their own and the clashes brought about through these two conflicting unions has been responsible for the tying up of work on upwards of 500 buildings besides resulting in considerable violence.



CELLAR PLAN OF THE WHITELAW REID RESIDENCE, NEW YORK, SHOWING HOT W



ELEVATION OF HEATING PLANT, RESIDENCE OF WHITELAW REID, THE BOILER BEING FOR EMERGENCY USE ONLY



ATER HEATING SYSTEM, THE WATER BEING HEATED BY STEAM THROUGH CONVERTORS

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THE public press has long since found it well worth its while to turn to the technical press for news relating to engineering operations or, at least, for confirmation of such news. This caution has so often been justified by the event that one would think the metropolitan papers would be the last to make random statements on engineering subjects. Yet the grave announcement was recently published in the New York dailies, under suitable headlines, that the well-known cooling plant in the New York Stock Exchange has been permanently shut down. While the direct cause was not disclosed, the intimation was given that the system did not preserve the desired degree of freshness in the air, for the reports stated that a burst of cheers from the assembled brokers greeted the opening of the long-closed windows.

The abandonment of so important a plant, presumably through no fault in its design or operation, appeared to be a calamity that called for a prompt investigation as constituting, if true, the most staggering setback in this line that the engineering profession has experienced in many years and one that might have a serious bearing on the development of standard cooling practice. We are gratified, however, to be able to state that the shutdown, so far from being permanent, was quite temporary, being due to the rather prosaic cause of the city's low water supply. The recent rains have entirely remedied this difficulty and the plant, we are informed, is again in full and successful operation, to the undoubted relief of an anxious profession and to the confusion of all carping critics.

A PERUSAL of Ohio's new building code, which is now at hand, discloses the fact that the code covers the ventilation, not only of theatres and assembly halls, but of school buildings and other institutions of learning, both public and private. In its requirements for private educational institutions the code goes further than any of the present statutes on the subject, with, possibly, the single exception of that in Massachusetts. There the law for private schools applies to those seating ten or more persons at one time, but no specified amount of fresh air is named, the only condition being that the method of ventilation shall be included in the plans deposited with the inspector. It would thus seem that for explicitness the Ohio building code, with its provision for six changes of air per hour for all schools, marks the most advanced step yet taken in the way of compulsory ventilation. The sections containing the heating and ventilating requirements referred to are reproduced in this issue.

Central Station Heating

By Byron T. Gifford

6—Management

(Previous articles in this series: "Pipe Line Losses from Radiation," April, 1911; "Rates," May, 1911; "'Ready to Serve' or 'Maximum Demand' Rate," June, 1911; "Operation," July, 1911; "Pipe Line Losses from Friction," August, 1911.)

The management of a public utility requires system as well as a lot of good common sense. The extent of the system that can be profitably utilized depends a lot upon the size of the utility. In other words, an elaborate system would be decidedly detrimental in a small organization, for there would not be sufficient employees to handle it and keep it going, to say nothing of keeping the plant itself going. Any system is liable to get top heavy if too elaborate and, on the other hand, a management without a system or plan of operation is an absolute failure.

To find the system best adapted to each case requires thought and study and, as stated, a good portion of common sense.

A good definition for the word system as used by public utility managers is "A plan of management," a general rule or set of rules guides the management of a property. The plan, or, at least, each one's part in it, should be indelibly stamped on every employee's mind. It should be easily understood and made plain to every man or woman in the organization.

It has been said that in unity there is strength. We cannot have unity without organization and we cannot have an organization without a system. System is as necessary in a public utility organization as laws are in a state. Without laws in a country we have anarchy and without system in a utility management we have failure. We have reached a point in public utilities where every manager realizes this point so that little can be said to strengthen the argument.

In adopting a system there are a few general points to be observed and kept in mind. The object of the system is to develop the utility to the best possible condition, both with respect to its physical condition and its financial condition.

In order to develop and maintain a good physical condition it requires experience and careful detail management.

To develop a good financial condition requires sometimes more than human effort can produce. But in many cases system will bring the desired result, provided, of course, that it is a possibility.

A central heating plant has three general features, like any other business:

First—We must manufacture our product, heat, as cheaply as possible.

Second—We must transport or distribute heat economically.

Third—We must make our product attractive.

Our field is limited to the city or district in which we are doing business and we are limited to this field. There is a definite and fixed number of consumers and a definite and fixed amount of business to be obtained; consequently, one important fact presents itself; never lose a consumer if you can keep him by reasonable and consistent means.

Owing to the peculiar attribute called human nature there are some people who cannot be satisfied and whom you cannot expect to keep as consumers, even if you are able to serve them originally. These people should be treated nicely, but forgiven and forgotten as soon as possible.

As a rule, quality of service is remembered long after the price is forgotten, so every means to give the best service should be employed. The price should be kept as low as can be done consistently without interfering with the good service necessary. The competition of the isolated heating plant is always sufficiently strong to prevent any danger from exorbitant charges. If a man can heat his building for $50.00 per year, it is difficult to get him to pay you $100.00, but do not overlook the fact that you heat him perfectly for 24 hours while he has been heating himself only part of the 24 hours. Remember, also, that after you have heated him perfectly for one season you have a lifelong consumer.

Now the point arises, how to give the consumer perfect service. This requires station capacity, pipe line capacity and sufficient radiation capacity in the consumer's property to give him sufficient heat. It often requires that attention be given to the condition of the consumer's buildings to see that windows are kept in proper repair, that bad and defective construction be remedied, that unnecessary ventilating ducts, such as chimneys, are closed tight and that wasteful methods of using heat be stopped. This should be done whether the heat is sold on a flat rate or meter basis. Of course, if the defect lies in the station or pipe line, it is obligatory on the part of the utility to remedy the trouble at once. If the defect is on the consumer's premises it is for the consumer to fix, but the utility management should guide the consumer in these necessary repairs and insist that the repairs be made without delay.

If the consumer's premises are in proper shape and proper repair over half the battle is won, but it often takes tact and untiring efforts to bring about this result. There are no set of rules that can be set down to guide the manage-

ment in this task. One thing can be noted, however, that if the management is doing all it can to remedy these little troubles, the consumers, if properly handled, will ordinarily meet it half way.

Do not suggest a repair unless you know it will be helpful to the cause. If you do you will lose the confidence of the consumers and nothing is as essential as the consumer's confidence in the management.

General rules and principles for pipe line troubles and repairs have been given under "Pipe Line Operation."

As to the system to be followed in the heating station so as to manufacture heat economically, a great deal can be said, but the operation of a heating station is so similar to the operation of any fuel-burning plant and these principles have been so generally expounded that it is considered needless to go into them in detail here.

A few of the more important points will be mentioned because they are so important and because they should be kept in mind.

The care of the boilers is very important. The management should know that the boilers are kept clean and should have a record kept of the time each boiler is cleaned. Do not depend on the record to know that they are clean, but see to it that they are cleaned both inside the tubes and outside. A personal examination of the boilers by the manager or his superintendent is often advantageous, especially to prove beyond a doubt that the system of watching this one point is working.

No boiler can be too clean. The combustion of the fuel is also very important and a system can be adopted that will materially advance economical operation. Flue gas analysis is essential in this connection. The check this has on the firemen is far reaching. It shows what economy is obtained and allows the weak points to be discovered and remedied. The point to be watched by the manager is that these tests are made regularly and a record kept so that they may be referred to at any time. It is often advantageous to work out a system of credits and debits which will increase or decrease the fireman's wages in proportion to the economy he develops. In a heating plant so great a percentage of the operating expense is fuel that a small leak in this department often means financial failure.

The kind of coal to burn, if a coal-burning plant, is decidedly important and the author's experience has been that an operating test is the only sure method of ascertaining which size and which quality of coal to buy. By operating test is meant a test that takes into consideration every possible phase of the operating condition, such as cost of fuel per 1000 lbs. of steam, or 1,000,000 B. T. U. generated by the boilers; the effect on the grates or stokers; the han-

dling of the ash; the labor handling the fires with the coal, etc. This test is invaluable to the manager and when the best grade and size of coal are known, a great deal of trouble and dissatisfaction is stopped.

This is one of the most difficult things a manager has to decide and, in order to decide it, a system must be used and used effectively.

In order to determine the cost to generate 1000 lbs. of steam or 1,000,000 B. T. U., it is necessary, of course, to measure the output of the plant. This can be done in a steam plant by measuring the boiler feed water and taking the temperature of the water before it enters the heater, or economizer, or by meter direct. In a hot-water plant the amount of water flowing should be measured and the temperature of the water, both flow and return, should be recorded. Recording meters and thermometers are made for this purpose and are very reliable. It is also necessary to keep a record of the weight of coal burned and, oftentimes, to keep a record of the ash removed, the number of times the boiler needed cleaning, the amount of time consumed in firing, cleaning fires and removing ashes. In this way the general result can be obtained in each of its separate parts and for each different grade of fuel.

The same system can be adopted in handling the machinery. A record should be kept of the time devoted to the repairs and maintenance of each piece of machinery, the amount of oil used and the cost of new parts. It does not take much of the fireman's time nor much of the engineer's time to keep these records and they are invaluable to the manager.

The manager should keep posted as to the weather. What the weather is going to be and what it has been. It is important to know if a cold wave is expected so that every part of the plant can be ready for it. The local forecast furnishes this information to a great extent. The advantage to be gained by a record of the weather (temperature, wind and humidity) that has passed, is of special benefit in handling complaints about extremely high monthly bills. In this connection it might be mentioned that a real live manager soon learns the habits of each consumer as to his economy or wastefulness in using heat. This is an important point and one that should be studied by every manager.

Recording gauges and thermometers should be used on every vital part of the system so that the manager can have a check on the operation of the plant at all times, and in that way can decide whether a complaint as to insufficient heat is justified or not.

The maintenance of the pipe line is not a large item of expense at any time, but it is decidedly important. If a leak

develops it can cause expensive trouble and should be fixed at the earliest possible moment. It not only wastes heat, but it has an exceptional deteriorating effect on the pipe and insulation. Expansion devices should be inspected regularly. Line traps and meters should also be watched and kept clean.

The consumer's equipment should be examined regularly. The meters and traps should be inspected and kept in good repair. Do not wait for a complaint before doing this. Do it of your own accord as it will win you a lot of friends and will materially reduce the number of complaints.

One of the greatest sources of complaint any utility can experience is that caused by the procrastination of its employees. If you have a complaint, remedy it at once or, at least, attempt to remedy it. Do not try to mislead your consumers. Be prompt and impress it upon your employees that proscrastination will not be tolerated.

New Business Department

This branch of central heating is especially important in a new plant. A heating plant designed to handle 200,000 sq. ft. of radiation cannot be made to pay with a small load connected; for that reason it is essential to load the plant as soon as possible. A new business campaign can be inaugurated that will pay big. Good, catchy advertisements will help and so will a personal canvass by the solicitors and the manager. Each particular case should be carefully handled and the manager can afford to give this department a large share of his time, especially after the plant is shut down in the spring.

Central heating is very attractive and after a consumer once has it he very seldom discontinues it, if the service is properly maintained. One satisfied consumer will bring you more, so do not be afraid to refer to your consumers as references. After a plant has been in operation a season or two, advertising will not bring large results, but the first year or so it helps wonderfully for it educates the public to see what a comfort and pleasure you have for them.

This branch of the business has been given a great deal of thought and study the last few years, and the results obtained are indeed gratifying.

The development of new business in central heating is more or less limited as compared with electric light and power. In a territory such as a central heating plant would serve, there is a greater volume of heating business than there is of electric business. This is especially true of the business district in a city and also true of the residence section. There are, of course, sections in every city where this is not the case, where large power loads are developed. From the above fact the electric end of a by-product plant

should extend into territory beyond the heating zone or, in other words, in order to keep the two loads well balanced it is often necessary to put a great deal of effort in the new business department of the electric plant to keep pace with the heating requirements.

Do not consider, however, that the heating business does not need attention for it does, although I think there is less trouble, per dollar invested and per dollar earned in a heating plant than any utility I know of, if the property has been built right at the start.

Another point which makes the new heating business department of a by-product plant necessary is the fact that all electric consumers are using more current per consumer than they used to. The introduction of fans, irons, washing machines and the like are developing the electric loads rapidly, thus allowing more waste steam to be used in the heating plant and, as it is desirable to make the heating plant earn as much per foot of pipe line as possible, it is better to develop the territory already served than to construct new lines. While our field is more or less limited to a given territory, a wonderful amount of business can be developed if the proper effort is made. The domestic hot water can be heated by the central station service and store windows properly heated and ventilated will be free from frost.

There are, of course, no bargains to be offered the consumer from time to time to induce new consumers to connect to the plant, but the comfort to be derived from the service is an inducement sufficient to bring a large volume of business, if the proper effort is made to acquaint the people with the facts. What can we imagine more delightful than a home heated evenly and sufficiently all winter from the time heat is needed in the fall until it is not needed in the spring, with a supply of heat that heats every room in the home at any time of day or night, with a supply of hot water for bath purposes always ready, with a supply of heat sufficient to heat any fresh air needed for ventilation and all this without one iota of trouble or annoyance to the consumer? Even though it does cost a little more than the isolated plant per year, which, by the way, is not always the case, the difference in cost is nothing when the additional comfort is taken into account.

In this article the author has tried to bring out a few of the important points in the management of central heating plants, but, after all is said and done, a lot of good business judgment will do more to attain success than anything else. A central heating plant is probably as easy to run as any utility. If any operator or manager gets a new thought or a new idea from this article its mission will have been accomplished.

Novel Experiments Being Conducted by the Chicago Ventilating Commission

In an especially fitted schoolroom of the Chicago Normal School some experiments in ventilation are being conducted by the Chicago Ventilating Commission in accordance with many of the ideas advanced by Dr. William A. Evans, until recently commissioner of health for that city.

As outlined by Samuel R. Lewis, the commission is seeking means to improve the air distribution, both in buildings heated by direct radiation and those mechanically ventilated.

"We found," said Mr. Lewis, "that we did not get air distribution unless the air was introduced much warmer than with ordinary outlets and inlets. In order to study this matter we have taken a standard class room and put in a false floor and ceiling, the false floor being raised up 16 in. from the floor. Under every desk is placed a 3-in. pipe. The air is introduced through these openings, numbering about fifty, one for each occupant of the room and is taken out through four openings in the false ceiling below the normal flow of air into the room. The room is occupied by adult people.

"By keeping careful record of the temperature of the air and by taking CO_2 samples and analyzing them as well as the dust by means of special apparatus provided by the Board of Education, and also by keeping a record of the health of the occupants, we will have, in the course of a year or two, some interesting and valuable data. I think that is the coming way to ventilate a room, because much of the time it is necessary to introduce the air at a temperature below the temperature of the room itself. The usual method of bringing the air in at the top and taking it out at the floor does not work when the air is introduced cooler than the air in the room."

Ventilation and Labor Efficiency

In a report made to the International Congress on Industrial Diseases, on the health of men working underground, Dr. Langlois, of Paris, gives some interesting facts relative to the effect on mine workers of humidity, temperature and air circulation. According to investigations made by Dr. Langlois he found at Ronchamps at a depth of about 3,280 ft., with the humidity such that the dry bulb showed 36.5° C., and the wet bulb 24.8° C., that work could be carried on, but that, when the humidity became greater even with a lower temperature, work became difficult. He found that with temperatures above 25° on the wet bulb, the ventilation has a marked effect on the workmen's physical condition and capacity for work. In stagnant air at the temperature of 25° (wet bulb), an appreciable illness is experienced, which passes off at once when the ventilating current reaches a velocity of 3.3 ft. per second. In still air at a temperature of 30° (wet bulb) marked illness is felt, but conditions become supportable when the velocity of the ventilating current reaches 6.6 ft. per second.

From these data it is evident that attention to ventilation in mines is an important factor in determining the labor efficiency of the underground workmen, especially in warm moist workings. Dr. Langlois found that a workman could do more work in a temperature below 25° (wet bulb) when the velocity of the ventilating current is maintained at 2 to 16.5 ft. per second.

Plan for Maintaining Efficiency of School Heating Apparatus

A plan to set aside a "wear and tear" fund for the renewal or remodeling of heating apparatus in school buildings is proposed by Charles F. Eveleth, engineer in charge, Schoolhouse Commission of Boston. Mr. Eveleth's recommendations are contained in the newly-issued annual report of the Boston Schoolhouse Department. In his report he mentions specific instances where the replacement of worn-out apparatus in two school buildings was passed over on account of lack of money.

This situation, he says, is becoming more serious each year. Unless some means is taken to secure a large appropriation for this purpose, so that the department can keep pace with the necessary renewals, it will shortly be brought face to face with the problem of immediate renewals and no available money. To repair a worn-out boiler in mid-winter, he points out, is not only a very expensive matter, but means the closing of the building until the work is completed and even then is merely a make-shift to tide over the cold weather. There is no economy in attempting to repack old-fashioned indirect radiators during the summer vacation, when it is extremely likely that they will leak two or three years later.

The only successful solution of the problem, in the opinion of Mr. Eveleth, is to set aside each year an amount of money sufficient to take care of the inevitable wear and tear. This means not only the replacement of the boilers, but also a gradual remodeling of the older system, so as to bring them up to the present standards.

There are a large number of buildings in Boston, for instance, some of them heated by furnaces and others by either direct, indirect or the older form of gravity indirect steam apparatus, which can be kept up to temperature in

zero weather only by forcing. When it becomes necessary to supply the ventilation of the present-day requirements by frequently flushing out the rooms with outside air, the apparatus cannot fulfil the conditions imposed upon it, to the discomfort of the pupils and teachers. Insufficient radiating and boiler surface, small piping, often buried underground and partially choked with scale and sediment, and wood vent ducts, restricted in area and discharging frequently into an attic space, cannot be expected to produce satisfactory results.

Only the lack of money prevents the Boston Schoolhouse Department putting into execution a plan which has been carefully prepared for systematically renewing each summer the systems in several of the schools. This arrangement carried on for a series of years would eventually put all of the apparatus in satisfactory condition.

At the close of his report Mr. Eveleth refers to a tentative project that has been prepared for a central heating plant to supply a number of Boston's school buildings which are now separately heated. It is proposed to make use of water tube boilers of ample capacity. With such a building nearly at the centre of distribution, the expense of laying steam mains to supply the various buildings would be a minimum one. The plan calls for the complete remodeling of the apparatus in two schools, substituting a plenum system of heating and ventilation in place of the present furnaces.

The report states that for a large part of the school year the demand for steam to supply the heating apparatus would be in excess of that required to operate engines for furnishing electric current for power and for lighting the entire group of buildings. With a market for exhaust steam the cost of producing electricity would be brought to the minimum. The building as proposed is of sufficient size to contain direct connected units without further extensions.

The following are some of the more important advantages of this plan:

1. Freedom from fire arising either from overheated boilers or spontaneous combustion of coal.

2. With the removal of the old type of heating apparatus and the installation of a modern system of air washing and humidification, the air supplied to the class-rooms would be thoroughly cleaned and purified, and in addition there would be an excellent opportunity afforded for a very thorough study of the benefits which it is claimed can be derived by humidification. There is no section of Boston where there is greater need for pure air than in this district.

3. Freedom from dust, soot and dirt in the buildings through the burning of coal and the removal of ashes.

4. It will be possible to produce steam with greater economy in a centralized plant rather than in several smaller plants.

5. With the responsibility for the heating apparatus of all the buildings centered in one person, there will be a more systematic effort to keep the temperature and air conditions in the various buildings at the proper point.

6. With the removal of the boilers and coal storage rooms from the basements of the schools there will be more space available for other uses.

Statistics of School Building Construction

An interesting table giving the construction statistics for 30 school buildings in Boston, erected since 1902, is contained in the report of the Schoolhouse Department of Boston for the year ending February 1, 1911. The table gives the cost of the buildings, the cubic contents and the number of pupils. An average has been compiled of the 30 sets of figures with the following results: The average cost of construction per cubic foot of space is 22.8 cents. The cost of the building contracts averages 83.7% of the total cost of the building with a range of 77% to 86%. The cost of the heating contracts averages 9.5% of the total cost of the building with limits of 7 and 15%. The cost of the plumbing contracts averages 4.6% and that of the electrical contracts 3.4% of the total cost of the building. Three of the 30 buildings are high school buildings and the average cost of building of the remaining 27 schools is per pupil, $178. The cost per pupil of the three high school buildings is $548.25, $940.65 and $495.19 and the cubic contents of these buildings are 1,267,608, 1,392,848 and 1,388,807 cu. ft., respectively; the number of pupils accommodated in these three buildings is 540, 350 and 600, respectively.

New Chicago Contractors' Association

A new contractors' association has been formed in Chicago known as the Building Construction Employers' Association. This body has been organized to succeed the Chicago Building Contractors' Council. In addition to the usual objects sought by such an organization the new body of contractors proposes, when one trade calls a strike, to lock out every workman in that trade, regardless of where he is employed in the city. When one or more trades go on sympathetic strike on any particular building, those trades are to be locked out on all buildings.

Annual Convention of National Association of Sheet Metal Contractors

Important actions taken by the National Sheet Metal Contractors' Association, at its recent convention in Omaha, Neb., included the adoption of the Federal Furnace League plan for rating warm-air furnaces on the heat unit basis instead of the cubic feet basis. Following the reading of a report to this effect by W. R. Taylor, chairman of the committee on warm-air furnaces, the following resolution, which was attached to the report, was unanimously adopted:

Whereas: we believe the present method of rating furnaces to be inaccurate and unreliable, and that furnaces should be tested and rated according to an adopted standard method; and

Whereas: there is in existence no standard, accurate rule for computing the heat requirements of a building, nor for the guidance of furnace dealers in the planning and installation of warm-air heating plants; and

Whereas: the Federal Furnace League, which is the only national organization of furnace manufacturers doing anything for the benefit of the dealer and for the perpetuity and upbuilding of the warm-air furnace business, and through it the only hope furnace dealers have of remedying the present existing deplorable conditions, and is now preparing, in consultation with the furnace committee of the National Association of Sheet Metal Contractors, a textbook embodying a set of standard authoritative rules for the guidance of dealers in the installation of furnaces, and is also testing and rating the furnaces of its members and assigning correct guaranteed capacity ratings to said furnaces; and

Whereas: we believe it is strongly to the interest of our members in the furnace business that furnaces be accurately tested and rated under a standard, uniform method, and that said members be furnished with authoritative rules for the installation of furnaces; Therefore, be it

Resolved, That the National Association of Sheet Metal Contractors approve this work the Federal Furnace League is doing, and request its members who purchase furnaces from manufacturers who are not members of the league to write or take up this subject with said manufacturers and request them to join the said league, that we may, through said manufacturers, enjoy the benefits and advantages to be derived therefrom.

The association reaffirmed its stand for the open shop and for no restriction of apprenticeship by voting down a resolution in favor of eliminating these principles.

St. Louis was chosen for the 1912 convention which will be held during the second week in June.

The following officers were elected for the ensuing year:

President, John H. Hussie, Omaha, Neb.; first vice-president, H. B. McGrath, Cleveland, O.; second vice-president, John Bogenberger, Milwaukee; third vice-president, Julius Gerrock, St. Louis; fourth vice-president, F. J. Hoersting, Dayton, O.; treasurer, W. A. Fingles, Baltimore; secretary, Edwin L. Seabrook, Philadelphia; trustees, H. W. Michael, Denver; T. P. Walsh, San Antonio; Walter Wimmer, St. Louis.

First Annual Meeting of Institute of Operating Engineers

A programme of ambitious scope marked the first annual meeting of the Institute of Operating Engineers, which was held in the Engineering Societies Building, New York, September 1-3, last. A portion of two sessions was devoted to the reading of technical papers, the subjects including "Temperature Changes and Heat Transmission," by Vernon L. Rupp, Chief Engineer Williamson Trade School; "A Boiler Room Analysis of Coal," by J. P. Fleming, Chairman J. T. Waters Branch; "Cooling Towers vs. Steam Pumps," by Henry W. Geare, Chief Engineer Peter Doelger's Brewery.

At another session a paper was read by James A. Pratt, director of the Williamson Trade School, on "A Method of Teaching Operating Engineering."

The branch of the institute located in Chicago is known as the T. J. Waters Branch No. 1, District No. 5, being named after the late Thomas J. Waters, engineer for the Chicago Board of Education.

A New Book for Ventilating Engineers

Under the heading, "Flow in Pipes," written in German by V. Blaess, D. Eng., the author takes up a thorough investigation of flow of liquids in pipes, particularly that of air of ordinary atmospheric conditions under low pressure, as applied to ventilation.

As a basis for his investigations the author introduces a new form of what is known as "equivalent orifice," his equivalent orifice being an ideal one, which would discharge, without forming "vena contracta," exactly the same quantity of, say, air as does a pipe of given length.

There exists an "equivalent orifice" for each of the three elements of resistance to flow in pipe; first, when friction only is taken in consideration; second, considering elbows only (these being taken as equivalent to a certain number of feet of straight pipe), and, third, considering the resistance due to "vena contracta" (entrance to the pipe, end of it and, generally speaking, any changes of the pipe shape. However

complicated the piping or duct system may be, it always can be subdivided into these three elements as to resistance, and equivalent orifices can be found correspondingly. Using a very simple way of "geometrical" addition similar to that which, in mechanics, is known as parallelogram of forces, the author figures out a resulting equivalent orifice for the whole piping, which would discharge exactly the same quantity of air as the piping itself does.

However simple this way of figuring the resulting equivalent orifice is, still it requires considerable time and in order to save this, the author uses, as a help, graphical methods in a separate volume of diagrams, which enable him, at the least expenditure of time, to find the final equivalent orifice for any piping or duct system.

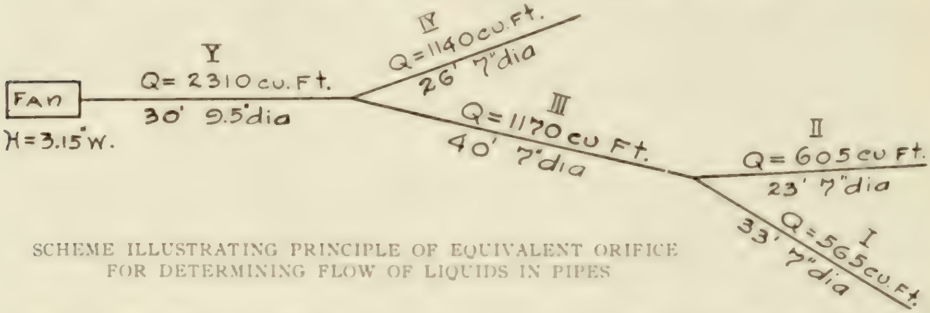
The author derives the following extremely simple formula:

$$A = \frac{Q}{C\sqrt{H}}$$

A = equivalent orifice in square feet.
Q = quantity of air discharged in cubic feet per minute.
C = constant.
H = total pressure in inches of water necessary to push Q cubic feet through pipes.

Quantity of air is usually fixed beforehand; equivalent orifice can easily be found from the volume of diagrams. Q and A being thus known, H can be figured out from the formula. If a fan is attached to the piping, H will represent the total pressure to be produced by the fan; with both H and Q given, it is a simple thing to select the fan. This procedure can particularly be applied to multivane type of fans, which, it is known, can be properly selected only when the pressure and capacity are known.

The conception of equivalent orifice greatly helps in understanding a good many intricate events of flow in pipes, which, at first glance, would seem to be paradoxical, if not impossible. The following example may serve as a striking illustration of what has been said. A piping, represented by the scheme above, was several times tested by the author in the most careful way and also figured on the basis of equivalent orifice. Final results are marked on the corresponding branches in the scheme. The reader will kindly notice that the branch III, though being considerably longer than the branch IV, carries more air than the latter. At first glance it would seem vice versa.



SCHEME ILLUSTRATING PRINCIPLE OF EQUIVALENT ORIFICE FOR DETERMINING FLOW OF LIQUIDS IN PIPES

Investigating a piping under suction, the author pays considerable attention to what is known as injector-like action of the streams of air with high velocity upon those with low velocity. Under certain conditions, he states, the velocity in some branches may become considerably higher than in the main duct behind those branches; the stream, having higher velocity, acts like an injector upon that of lower velocity, thus acting in a way of increasing the suction in that part of the main duct. This increase of suction is sometimes as high as 20% more than the suction measured immediately at the entrance into the fan.

The last two chapters of the book are devoted to the theory of fans and measurements of pressure and velocity in ducts in accordance with the newest scientific methods.

The book is apparently written by a man of practice, by the way it treats the different problems which a ventilating engineer encounters in his every-day practice, and no doubt would prove of great interest and value to anybody who is desirous of working himself as deeply into problems of transporting air by means of fans and ducts as modern science permits.

The book, which, as stated, is in German, has only recently appeared and can be had from the publisher, R. Oldenbourg, Munich and Berlin, Germany.

Building for Profit, embracing principles governing the economic improvement of real estate, which was recently published, has already reached its second edition. This work is from the pen of Reginald Pelham Bolton, who is president of The American Society of Heating and Ventilating Engineers. The subject matter has special interest for the architect, the engineer and the public

generally, as it presents much new material relating to the subjects of increase and depreciation in values of land and buildings, the bearing of taxation on values and rentals, the relative costs and values of buildings and land, the difficulty of limitation of heights of buildings, the costs of operation compared with rentals in office, loft and apartment buildings, and detailed methods and facts relating to depreciation of machinery. The book is liberally illustrated with diagrams, tabulations and photographic views. Published by the De Vinne Press, New York. Pp. 124. Size 8x11 in. Price, $2.00.

Current Heating and Ventilating Literature

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

BLOWERS

Application of Gas Engines to the Driving of Blowers. Illustrates and describes an arrangement of internal-combustion engine coupled to turbine-type blower. 1200 w. Mech Engr—June 2, 1911. 40c.

HOT BLAST SYSTEMS

Some Problems in the Heating and Ventilating of Factory Buildings. Am Arch.—June 14, 1911. 4 figs. 1000 w. Describes hot-blast systems in two factories. 80c.

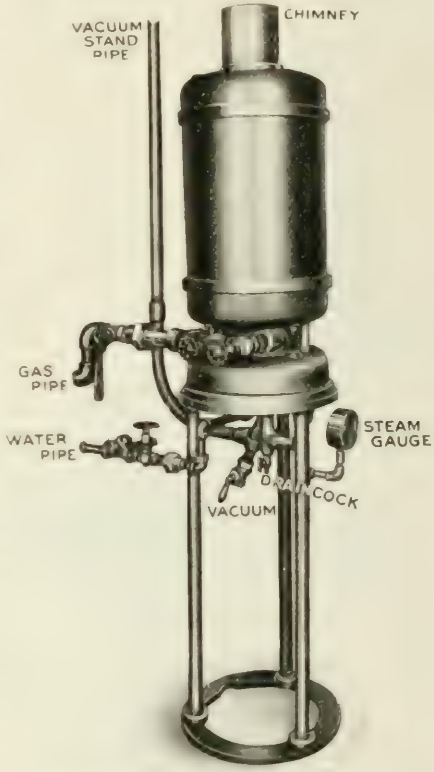
STEAM HEATING

Some Points Involving Mechanism and Advantages of Vacuum Steam Heating. J. W. Hook. El Rev & W Elecn.—June 17, 1911. 2900 w. 20c.

NEW DEVICES

The "Purifier" Vacuum Cleaner

A unique type of vacuum cleaner, built on the principle of the White steamer for automobiles, has recently been placed on the market by the Sanitary Vacuum Cleaning and Power Co., of Brooklyn, N. Y. It is a stationary cleaner installed in the cellar and operated by gas. It can be placed in any house piped for water and gas. This machine consists of a number of hollow cast-iron sections fastened together by an ingenious system of small riser tubes. Passing up between these sections are two pipes, one a water pipe connecting at the top with the uppermost section, the other a vacuum pipe, the open end of which is about an inch above the upper cross section. Connected with the lowest cross-section is a small ejec-



THE PURIFIER VACUUM CLEANER, A STATIONARY MACHINE OPERATED BY GAS

tor, which in turn connects with the vacuum pipe. At its lower end the vacuum pipe passes from the machine and connects with a standpipe, running from the upper floors of the house to the machine in the cellar. The water pipe passes out from the bottom of the machine to a connection with the house water pipes, the supply of water being regulated by a needle valve. Under the castings and forming the base of the machine is a cast-iron circular fire box into which the gas is admitted. In front of this, and separated from it by a short distance, is the pipe running from the house gas connections, with the necessary valves. The gas jumps across this opening, drawing air in with it, and ignites within the circular chamber, the flame passing up between and around the cross sections, the vacuum and water pipes and then out over the top section into the chimney. Surrounding the sections is a cover of asbestos,

and another of sheet-iron. The whole machine is 11 in. x 22 in. in size and weighs about 125 lbs.

In its operation the gas is first lighted and the machine allowed to get thoroughly hot. Then the needle valve on the water pipe is opened and the water admitted. It passes to the top of the machine, enters the upper section and begins to flow downward, circulating through the sections and forming into steam. This steam, in turn, becomes dry and highly superheated, and thence passes through the ejector into the vacuum pipe, being discharged upward into the chimney, an always open safety valve preventing the possibility of any explosion. The discharge of the steam in this manner draws all the air out of the vacuum standpipe, creating a vacuum as high as 15 or 17 in., depending on the steam and water pressure; but this vacuum can be lowered to 8 or 10 in. and a greater volume of displacement provided, if desired. The discharge of steam being steady, the exhaust of air from the vacuum pipe is also steady and a strong continuous suction is created, which gives a high cleaning power to the machine. The dirt taken up by the cleaning tools passes through the heated part of the tube in the machine, through the superheated steam and at the top through the burning gas. Everything which will burn is consumed and the non-consumable material (such as grains of sand, etc.) is discharged through the chimney.

THE PURIFIER VACUUM CLEANER USED AS A POWER GENERATOR

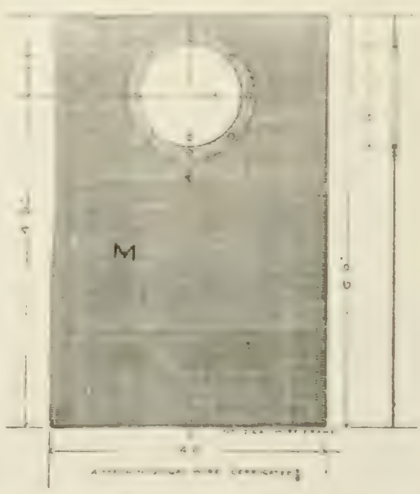
In its operation this machine consumes about 100 cu. ft. of gas per hour. It is not intended, however, merely for a vacuum cleaner, as it can be used as a power machine also, operating a small motor, and at the same time creating and maintaining a vacuum of from 5 to 8 in. The company, at its demonstrating rooms in Brooklyn has a ½ H. P. engine, run by one of its machines, which is also creating 7 in. of vacuum at the same time. It can be applied also to heating purposes. Owing to the fact that the water and steam pressures automatically regulate each other, thus insuring safety, and the further fact that it is practically as simple to operate as the gas range, its use requires neither license nor the employment of skilled mechanics.

The Krause Dust Collector and Filter

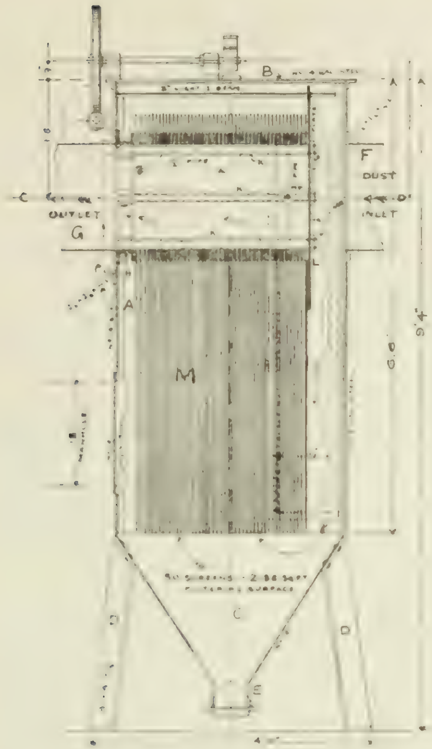
The accompanying illustrations show the construction of a new type of dust collector, or air filter, designed especially for removing finely suspended dust resulting from the manufacture of refined sugar, coffee, spices, drugs, chemicals, etc.

It may also be used for the filtration of flue and other gases containing valuable by-products, as well as for the purification of air in public and private buildings for the purposes of ventilation, heating, cooling, etc. The patentee of the device is A. F. Krause, 345 Fairmount avenue, Jersey City, N. J.

The filter is notable for having an unusually large amount of effective filtering surface attainable, also for the ease with which the filtering surfaces may be cleaned and automatically kept in effective and proper condition.



ARRANGEMENT OF WIRE SCREEN, KRAUSE DUST COLLECTOR

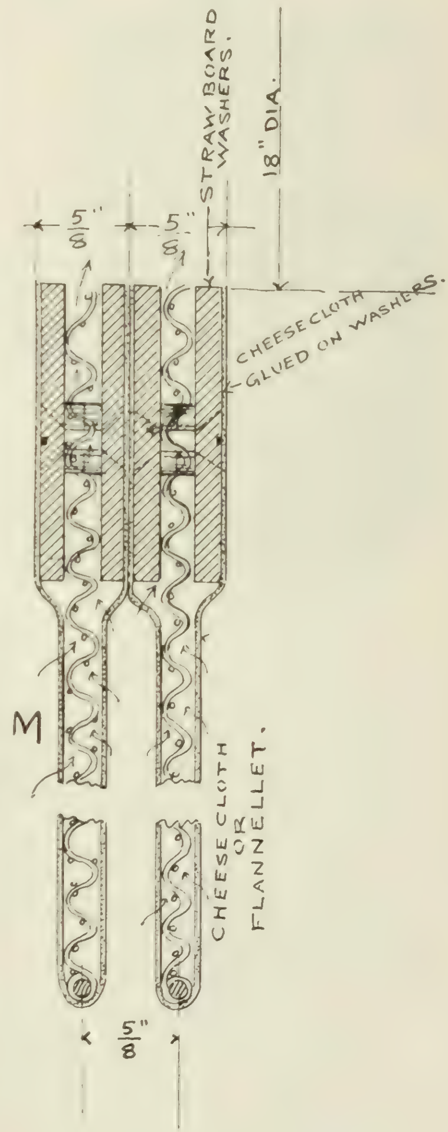


CROSS SECTION THROUGH SCREENS.
KRAUSE DUST COLLECTOR

The air passing through the filter may either be forced by means of a pressure blower connected to the inlet F, or it may be drawn through by means of a suction fan connected to the outlet G. The dust collector shown in the illustrations contains 50 filtering screens which are made of four-mesh No. 20 galvanized wire, corrugated with ⅜-in. corrugations and framed all around with No. 12 galvanized wire, sleeve jointed, the meshes of the wire being bent around the frame as shown in the detail. Covering the entire body of each screen is a layer of cheesecloth, flannelette or other suitable air or gas-filtering fabric, sewed close to the edges of the screen and glued fast to the collars.

Each screen is 4 ft. x 6 ft. and contains 42.72 sq. ft. of effective filtering surface, thus making for the entire 50 screens a total filtering surface of 2136 sq. ft. within a floor space of 3 ft. 4 in. x 5 ft.

In order to keep the filtering surfaces up to their full efficiency, a vibrating, or knocking arrangement is provided on top of the apparatus, as shown, actuated by a worm gear, which is regulated to give a knock at regular intervals so as to shake the dust from the filtering surfaces and to permit it

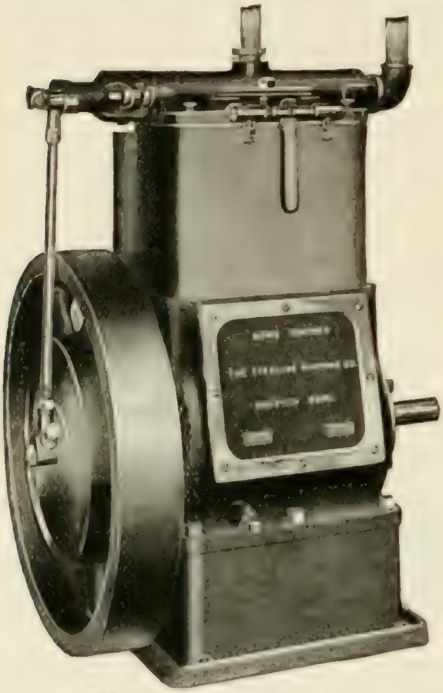


FULL SIZE SECTION AT A-B AND C THROUGH WASHERS AND SCREENS, KRAUSE DUST COLLECTOR

to fall below into the hopper C, from whence it may be removed from time to time through the outlet E.

An Improved Type of Small Steam Engine

With the rapid growth and popularity of the gas engine the impression has become quite general that the small steam engine is no longer an important factor in engineering fields.

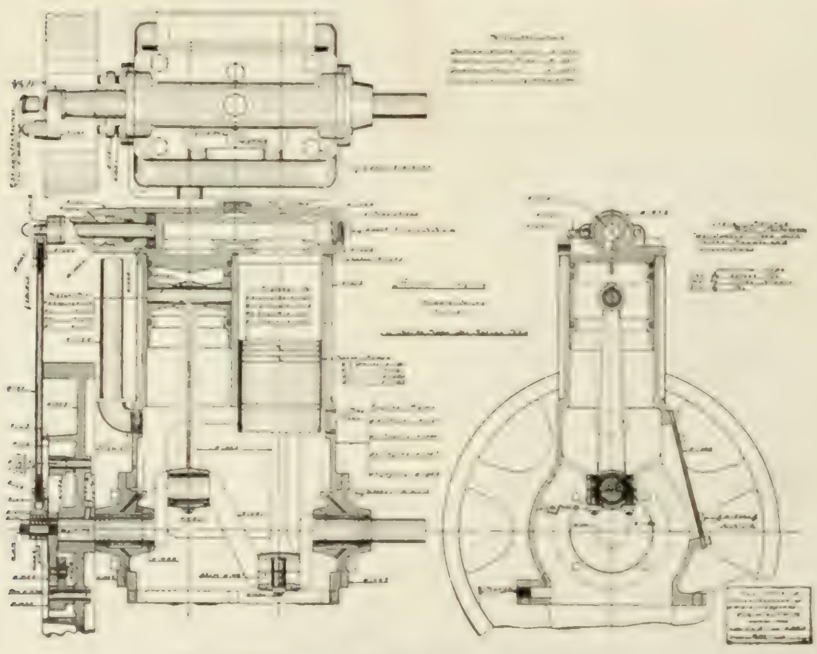


THE ACME STEAM ENGINE

This impression is hardly justified, according to the experience of one of the large manufacturers of small steam engines in this country. This firm states that the mechanical stoker and similar advances in steam engineering have made the small steam engine indispensable and more essential than before. This is said to be particularly true in plants where steam is a source of power, for in such plants the small steam engine proves an auxiliary which is very hard to equal both from the standpoint of economy and efficiency.

The Acme engine, formerly manufactured by the Rochester Machine Tool Works, Rochester, N. Y., and now by the Sterling Machine Co., Norwich, Conn., is a well-known type, having been manufactured for the past twenty years and improved from time to time to meet the demands of the day for a rugged, simple and economical unit.

The manufacturers have recently added some interesting features to this engine, which is of the vertical, 2-cylinder, single-acting enclosed type, with a balanced rocking valve and are splash lubricated. The engines are built in three series of sizes, the small series being $2\frac{1}{8}$ in., 3 in., 3 5-16 in. and $3\frac{1}{2}$ in.

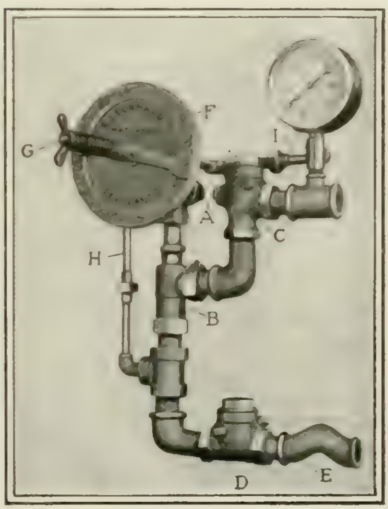


CROSS-SECTION VIEW OF THE ACME ENGINE

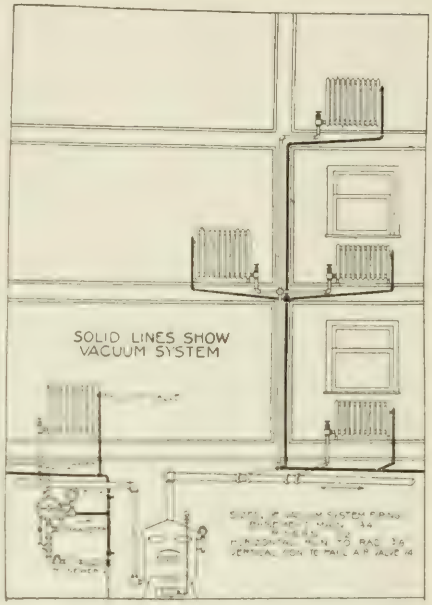
stroke. These small engines are identical in external appearance. The middle series is 3 5-16 in., 4 in., 4 9-16 in., 5 in. x 5 in. stroke These four sizes are also identical in external appearance and practically of the same weight. The large series of three engines is 5 in., 6 in. and 7 in. x 7 in. being also of the same external size and general appearance. This range of sizes covers all the applications to which these engines are especially adapted. Because of the simplicity of construction, the type of valve which adjusts itself to wear, the large bearing surfaces which are well lubricated at all times by a splash of oil, they are especially well suited for direct connection to small gear driven pumps, any variety of belt or direct-driven pumping machinery for contractors or irrigation purposes and for small plants such as laundries, creameries, etc., and they have been adapted in a number of instances to marine service such as lighting, driving ammonia compressors, ventilating fans, etc

A New Vacuum Heating System Air Exhauster

A unique device for creating and automatically maintaining a vacuum on a steam-heating system is known as the Leonhard automatic water-driven air exhauster. It is made and sold by Frederick Leonhard, 536 East 123d street, Cleveland, O. The device is designed for use in connection with Paul automatic air valves on the radiators, the operation being similar to that of the Paul vacuum system. The Leonhard air



LEONHARD AUTOMATIC WATER-DRIVEN AIR EXHAUSTER



TYPICAL INSTALLATION OF GRAVITY RETURN STEAM HEATING PLANT, WITH LEONHARD VACUUM SYSTEM

exhauster is made entirely of metal, with copper and bronze diaphragms, the central movement of which is 1/32 in.

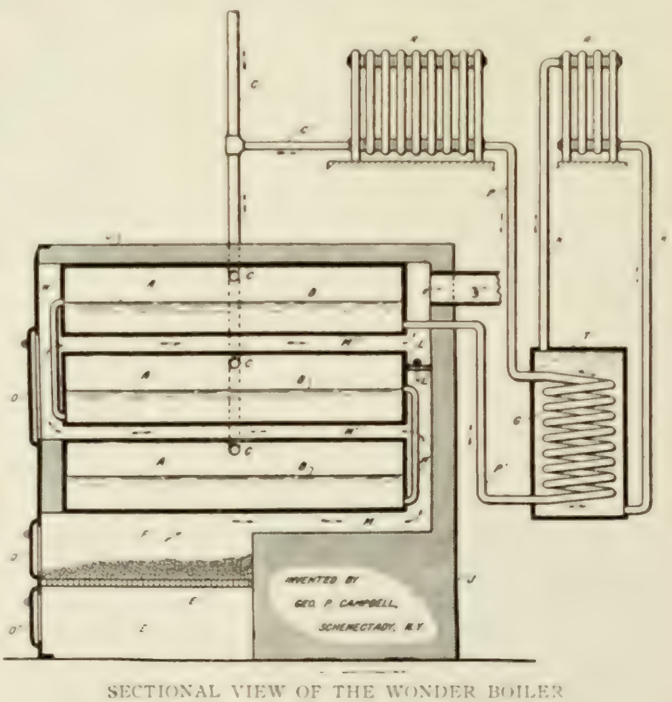
City water is used to operate the device. The water pressure enters at A and raises a differential plunger within the plunger casing or cylinder, allowing full water pressure to pass through a ⅛-in. orifice or jet in ejector B, thus drawing the air out of the air lines through check valve C and discharging air and water to the sewer through check valve D and seal E. Opposite the inlet A to the plunger casing or cylinder is a nipple to which screws the diaphragm bowl F. Through the center of diaphragm bowl F passes spindle G, which seats directly on a very small by-pass or relief port near the top of plunger cylinder. The spring on diaphragm spindle G keeps the spindle away from the seat 1/32 in., allowing the water that seeps past the plunger to by-pass through the ⅛-in. pipe H, and thus prevent pressure from forming on top of the differential plunger. Between the spindle G are locked two metal diaphragms, one at the top of diaphragm bowl and one at the bottom, thus forming a vacuum chamber from which the air is drawn through ⅛-in pipe I. Therefore, if the spring or diaphragm spindle G is set so that 4 in. of vacuum will draw the diaphragm in (dish it) 1/32 in., the spindle G will seat on the by-pass port, permitting pressure to form on top of the differential plunger, which suddenly brings the plunger down on its seat, shutting off the

water from the ejector suddenly. On the other hand, when the vacuum falls to 3 in., the spring draws the spindle G from the by-pass port, relieving the pressure from the top of the cylinder and permitting the plunger to raise suddenly and open full the water passage to ejector B.

For creating a vacuum where high pressure steam is available, a steam-driven air exhauster is furnished.

The Wonder Boiler

A new type of boiler, the invention of George P. Campbell, 740 Brandywine avenue, Schenectady, N. Y., is notable for having three water lines, three steaming surfaces and three steam domes. The inventor advises us that he has a boiler of this type in use in his own residence, a two-flat house, which heats both flats. It is made of steel set up in brick. A record made of its operation on February 16, 1911, showed that with the outside temperature 5° F. below zero, the temperature at 6.30 a. m. in the second or upper flat was 73°, the heater having had no coal since 10 o'clock the night before. This was without the aid of the kitchen range. At the same time the temperature in the smoke pipe was 148°. By reference to the illustration, it will be noted that the pipe line C connects all three boilers together and makes a steam passage to radiator R. After steam is condensed in radiator R, it passes to the coil G, then to the upper boiler where it is reheated. Then it flows through pipe W¹ to the middle boiler and finally to the bottom boiler through pipe W. The hot gases and the water pass through the boiler in opposite directions, thus bringing the coldest water in contact with the cooler gases. The radiator R is a hot-water system attached to the water line P to remove the heat from the condensed steam before it returns to the boiler. L is a damper for use in the event that increased draft is required, as it makes a direct connection with the smoke pipe.



SECTIONAL VIEW OF THE WONDER BOILER

Lagonda Automatic Cut-Off Valve, made by the Lagonda Mfg. Co., Springfield, O., is the only valve which has been admitted, up-to-date, to the Museum of Safety Devices, which is maintained in the Engineering Societies Building, 39 West 39th street, New York. The valve, as described in recently-issued circular matter, is so made as to close automatically if a break occurs on either side of the valve. The circular describes some tests made at Washington in January, 1909, in which a 4-in. valve was used, showing the reliability of the mechanism.

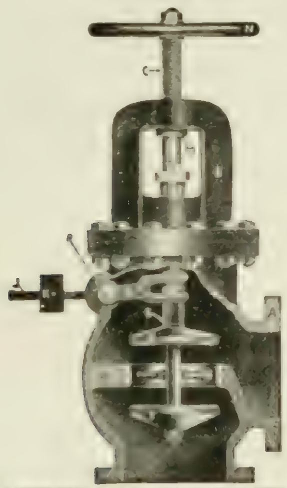
The tests were arranged for the Board of Supervising Engineers of the Department of Commerce. The accompanying diagram shows the arrangement for the tests and it was possible to duplicate at the trial any circumstances which the valve might be called upon to meet. For instance, by closing the quick opening valve D and then opening it quickly the same condition was obtained as would result from a break in the steam line between the valve and the engine. By closing and opening the quick opening valve E it was possible to duplicate the various circumstances which would be liable to arise due to a break between the valve and the boiler, such as the blowing out of a boiler tube or bursting of a mud-drum.

The following gives the results of some of these tests. Various trials were made representing breaks in boiler tubes, and in every instance the valve

closed promptly, even when the outlet for the escaping steam was only equivalent to a 1 5-16-in. opening.

To test the action of the valve in case of a break in the header, the quick opening valve was opened in two seconds, the amount of the opening being equivalent to an outlet of 1½ in. in diameter. Steam pressure was only reduced from 180 to 140 lbs., but the rush of steam through the valve caused it to close instantly.

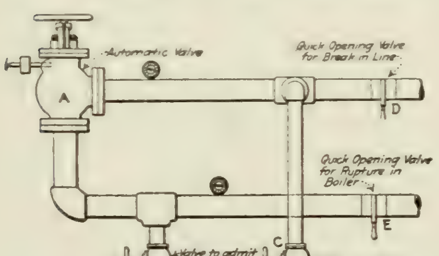
A somewhat similar test was made in which the outlet was equivalent to a



CROSS SECTION OF LAGONDA AUTOMATIC CUT-OFF ANGLE VALVE

1¾-in. opening. In this case the valve opened in three seconds, and the pressure dropped from 180 to 120 lbs., at which point the valve closed immediately. These tests show that the valve will operate even if a steam main should only split for a short distance.

The following test was then made to



ARRANGEMENT OF PIPING IN TESTS OF LAGONDA VALVES

see how the valve would act where a sudden or unusual supply of steam is required, as is often the case in electric light and power plants and rolling mills. The first test was with 1½-in. opening. The quick opening valve was opened slowly, covering a period of thirty seconds. The steam pressure dropped from 180 to 90 lbs., but the automatic valve remained open.

In another test, similar to the above, only eight seconds were used in opening the quick opening valve. Steam pressure again dropped from 180 to 90 lbs., and the valve remaining open.

In the third series of tests only 5 seconds were consumed in opening the quick-opening valve, the automatic valve in each instance remaining open. After each test in this series, the quick-opening valve was opened at one movement and the automatic valve went promptly to its seat. These showed that the valve would take care of any unusual but legitimate demand for steam, and would also promptly close under sudden rush of steam, such as would occur in the case of a rupture in the main.

Advertisers' Index

TRADE AND MISCELLANEOUS NOTES

Deaths

C. M. Kemp, president and founder of the C. M. Kemp Mfg. Co., manufacturers of pipe threading machinery, Baltimore, Md., died at his home in that city, July 24. Mr. Kemp was 59 years old. He once ran for mayor of Baltimore on the silver Democratic ticket, having been a warm supporter of William J. Bryan and the principles he advocated. Mr. Kemp was notably generous to his employees and had adopted many of the modern co-operative principles in his business.

George Lane, one of the founders of the present firm of Mayor-Lane Co., dealers in heating and plumbing supplies, died at Westchester, N. Y., at the age of 71 years. He retired from business several years ago.

Miscellaneous Notes

Prof. John R. Allen, of the Department of Mechanical Engineering, University of Michigan, Ann Arbor, Mich. sailed for Constantinople, Turkey, July 29, to complete the equipment of the Engineering Building of Roberts College at that point. Prof. Allen, it will be recalled, spent some time in Constantinople about a year ago, having been engaged to design the equipment for this department of the institution.

Lebanon, Ind.—The Lebanon Heating Co., organized two years ago with a capital stock of $75,000, will be sold to a new company which will assume the present company's debts, amounting to $75,000. As this is the only consideration in connection with the purchase the former stockholders will lose the amount of their holdings.

Philadelphia, Pa.—A company is being formed to supply Trappe with electricity for heat and power.

Compulsory ventilation of London tenements is provided in a new by-law proposed by the Paddington Borough Council, one of the metropolitan bor-

oughs. It reads as follows: "It shall be compulsory for all windows of sleeping apartments to be opened wide for at least two hours a day, and for floors to be swept once a day and washed once a week." It is proposed to appoint inspectors with right of entry into the houses to see that the regulations are observed. The maximum penalty for breach of these laws will be $25, and $10 for each day the offense is continued.

Terminal Freezing and Heating Co., Baltimore, Md., capital $1,600,000, half preferred and half common stock, has been organized by the leading directors and stockholders of the Baltimore Refrigerating and Heating Co., to take over the business of that concern, which has been for some time in the hands of a receiver. Among the incorporators are Francis T. Homer, E. Clay Timanus, Marshall Winchester and Michael Schloss. These, with Horace P. Serrill and Harry F. Ambler of Philadelphia, and Robert H. McNeall of Washington, D. C., will constitute the board of directors for the new concern.

Chicago, Ill.—T. B. Dean, of Chicago, has been awarded a 25-year franchise by the Board of Public Works of Gary, Ind., for the erection of a central steam heating plant in Gary and the right to lay pipe lines along the principal streets. The heating plant will be built at once and the power plant will cost $30,000. According to the terms of the franchise the city will have the privilege at the end of 25 years of buying the plant and no value is to be placed on the franchise at that time. It is also provided that flat rates of not to exceed 35c. per square foot of direct radiating surface exposed for the season shall be charged. There will also be a meter rate of 60c. per 1,000 lbs. of condensation. Another meter rate will provide for a discount of 10% when paid in advance. The city buildings are to be given a rate 25% less than the commercial rates.

Modern Science Club, 125 South Elliott place, Brooklyn, N. Y., announces that, in addition to the regular Tuesday night lectures, the club's proposed educational programme for the season of 1911-1912 will consist of two courses of 30 lectures, each on subjects bearing directly on the vocation of steam engine operation. The first course will commence October 6 and will embrace mathematics for engineers, including the slide rule, natural philosophy and graphical statics. The second course will commence October 9 and will consist of lectures on fuels, their origin, nature, characteristics and analysis; steam, its generation and distribution in engines, pumps and turbines, theory and practice in the use of condensers, including their design and installation; steam engine design and operation; theory of the turbine, both impulse and reaction; the indicator and its application; the slide valve diagram and its value in steam engine design; internal combustion engines, including gas producers; flue gas analysis and general engine and boiler-room chemistry. The club will open its season September 26 with a beefsteak dinner and reception to the national and state officers of the National Association of Stationary Engineers. A unique method has been adopted for making the

club's announcements. Two calendars are sent to each member, one for the office and one for the home. Inserts are to be sent monthly giving the club announcements in detail, with a calendar for the month, having the club dates in red.

Dravo-Doyle Co., Pittsburg, Pa., which has had an experience covering a period of 20 years in the construction and operation of power plants, announces that it has added a steam specialty department to its business in charge of J. C. McAllister, Jr. This department is prepared to offer reliable steam specialties, such as steam traps, back pressure valves, pressure-reducing valves for all services, etc. The company maintains branch offices at Cleveland, Chicago, Philadelphia and Huntington, W. Va.

Manufacturers' Notes

Pullman Ventilator Co.'s plant at York, Pa., has been sold to a syndicate, of which one of the principal members is Freeman Allen, Rochester, N. Y. It is reported that a new corporation will be formed with a capitalization of $300,000, which will absorb possibly three other manufacturers of automatic ventilators.

American Radiator Co., Chicago, Ill., has let the contracts for the construction of its new building at Bayonne, N. J. The building will be two stories high, and will occupy a lot 280 x 287 feet. It will cost about $200,000. The company is also building a $25,000 brick foundry building at its Piece plant in Buffalo, N. Y.

Robertshaw Mfg. Co., Pittsburg, Pa., has taken over the business of the House Service Utilities Mfg. Co., of Pittsburg. The company will manufacture the Robertshaw Thermo valve and the other specialties heretofore made by the House Service Utilities Co. New quarters have been secured at 101-103 Water St.

McDonald Bros. Co., Cleveland, O., announces that it has moved to new quarters in the Swetland Building, on Euclid avenue.

H. Mueller Mfg. Co., Decatur, Ill., manufacturer of heating, water, plumbing and gas brass goods, is arranging to establish a manufacturing plant in Canada to supply its large and rapidly growing Canadian trade. The site for the new plant has not yet been decided. The company intends to make its Canadian plant a permanent one and Adolph, Philip and Oscar Mueller, who have recently been in Canada, have expressed themselves as deeply impressed with the marvelous business, manufacturing and agricultural possibilities of the country. At present from 60 to 70 of the Mueller's company's 900 employees are kept busy on goods for the Canadian trade and

the new plant will start with at least that number of hands. The company has catered to the Canadian trade under the handicap of a 30% customs duty. A warm welcome awaits the company in Canada, where the advantages of various locations have been vigorously urged by the local interests.

Trade Literature

Modulation System of Steam Heating in an Office Building, Also Results of a Test is an illustrated description of the heating plant installed in the Haynes Building, Boston, Mass., published by Warren Webster & Co., Camden, N. J. The plant is described in detail from an engineering standpoint, the views including the heating layout for the basement and first and second floors of the building, in addition to those showing the application of the Webster Modulation system.

In the same pamphlet is published a test of a Modulation heating system made in an office and warehouse building in Montreal. Size 6x9 in. (standard). Pp. 12.

Webster Vacuum Heating System in the Boston City Hospital and Webster Modulation Steam Heating and Air Washing Systems in the Boston Safe Deposit and Trust Co. Building are the titles of similar pamphlets of 16 and 12 pp., respectively, giving the details of these two important installations. In the Boston City Hospital steam is supplied through mains over 1,000 ft. in length.

Still another publication is entitled "Modulation System of Steam Heating in the Sumner Apartments," showing the general method of application of this system to apartment house heating. Any or all of these pamphlets, we understand, will be sent upon application to the company at Camden, N. J.

At Last a Packless Water Valve is the subject of a circular that is being sent out to the trade by the United States Radiator Corporation, Detroit, Mich. Exterior and interior views are shown of this valve which is known as the Triton Packless Water Valve. The company is prepared to furnish full descriptive circular and prices to those interested. Other circular matter issued by this company describes the Capital radiator shield which is built in three lengths, although, on special order, shields of any exact lengths will be made. A feature of the Capitol shield is a patent dust retainer attached to the shield, which can be lowered for the purpose of cleaning. This device is designed to catch all dust particles which circulate in the air currents arising from the radiator.

A third circular describes the Capitol improved sectional boilers which are made for both water and steam, the capacities ranging, for water, from 750 to 14,100 sq. ft. of radiation and, for steam, from 450 to 8,550 sq. ft. radiation. Fine points about the Capitol boilers are stated to be the countersunk header, long flue travel, extension heating surface, thin waterways, slip-nipple connection, divided sections, large flues, deep firepot, double shakers and convenient shaking apparatus.

New Firms and Business Changes

Cook & McDonnell, 320 Insurance Building, Oklahoma City, Okla., is the title of a new heating and ventilating engineering and contracting firm recently established in Oklahoma City.

New Incorporations

Toledo Mfg. & Supply Co., Toledo, O., capital $10,000, to manufacture steam fitting and plumbing supplies. Incorporators: Sigmund Sanger, Trude Wooster, K. A. Kaley, George P. Hahn, and F. W. Widmaier.

Mehring & Hanson Co., Chicago, notice of whose organization was published in last month's issue, has been incorporated with a capital of $40,000, to conduct a heating and ventilating business.

Mass & McAndrew Co., Rochester, Minn., capital $60,000, to conduct a heating and plumbing business. Among the incorporators is Ernest Mass.

Standard Vacuum Cleaner and Sweeper Co., San Francisco, Cal., capital $100,000. The incorporators include T. E. Pope, G. A. Pope, H. H. Sebree, J. W. Geary and A. B. Bennett.

Excelsior Co., New York, capital $500,000, to manufacture valves and plumbing supplies. Incorporators: I. B. Wood, I. Sternfield, and W. D. Cushman.

Charles M. Oberlin & Co., South Bend, Ind., capital $10,000, to conduct a heating and plumbing business. Incorporators: C. M. Oberlin, I. J. Miller and M. F. Ritter.

Rock Island Register Co., Rock Island, Ill., capital $30,000, to manufacture and deal in heating and ventilating apparatus. Incorporators: J. T. Burgess, S. P. Burgess and Jens Nielsen.

Laramie Heating Co., Laramie, Wyo., capital $75,000.

Vaporlite Co., New York, capital $500,000, to deal in heating and lighting appliances. Incorporators: W. P. Pritchard, E. P. Cooke, H. B. Baker, New York.

J. Looney Co., 85 City Hall Ave., San Francisco, Cal., capital $50,000, to conduct a heating and plumbing contracting business. Incorporators: R. H. Griffiths, J. Looney, W. T. Elliott, James Mearns and James Reilly.

Ideal Plumbing & Contracting Co., North Milwaukee, Wis., capital $16,000. Incorporators: Theodore Walch, Otto Seefeld and Ernst von Briesen.

New Contracts

Taylor & Co., Boston, Mass., heating Waterville High School in Waterville, Me., for $3,684. The plumbing contract went to Gideon Picher, Waterville, at his bid of $2,475.

W. A. Stuart Co., Livermore Falls, Me., steam heating high school building at Livermore Falls for $3,500.

M. J. Holmes Co., Worcester, Mass, heating Thomas Street School in Worcester for $4,431.

Nicholas J. Smith, Worcester, Mass., heating Elizabeth Street School in Worcester for $6,080.

Bartley, Kennedy & Co., Pittsburg, Pa., steam heating new school building at Beaver Falls for $4,700.

McGinness-Smith Co., Pittsburg, Pa., heating and ventilating new Mt. Washington sub-district school for $8,000; heating Christian Church at Newcastle for $3,000; also heating new Crutchfield-Woolfolk Building at Penn and Shady Avenues, Pittsburg, for $5,000.

Lewis & Kitchen, Kansas City, Mo., heating addition to the Ashland School in Kansas City for $3,935.

Laskey & McMurrer, Boston, heating and ventilating new Aquarium Building at City Point, Boston, for $15,887. Other bids were: L. W. Taylor Co., $17,283; J. J. Hurley, $20,540; Pierce & Cox, $22,195; Ingalls & Kendricken, $24,240; William H. Gallison Co., $24,590; Lynch & Woodward, $19,870; James P. Dwyer, $18,647; A. B. Franklin, $21,615.

Johnstown Supply House, Johnston, Pa., heating, ventilating and plumbing Cambria Theatre.

Meyer Merc. Co., Delta, Colo., heating new high school building at Paonia for $5,000.

Stapel Heating and Ventilating Co., Montgomery, Ala., heating new wing of the Capitol for $3,750.

C. A. Salisbury, Atlantic, Ia., heating and plumbing new Whitney Bank building at that place.

C. M. Masters, Mankato, Minn., central heating plant for the Mankato Normal School. The plant is to be finished by November 15, work having been begun in August, and will cost $7,923, outside of the building itself which will cost $12,238, the J. B. Nelsen Construction Co. having the building contract.

Salina Plumbing Co., Topeka, Kan., heating, plumbing and lighting for new Memorial Hall at Topeka, for $9,800.

Atlanta Steam Heating Co., Atlanta, Ga., heating Auditorium of that city for $4,839. A hot blast system will be installed. Other bids were: Englehart Heating Co., $5,579; Mongrief Furnace Co., $5,626.42.

A. J. Anderson & Co., Louisville, Ky., heating and ventilating Girls' High School building in Louisville for $29,566; also heating and ventilating addition and gymnasium of the George Rogers Clark School for $1,075.

Harstick Heating Co., Memphis, Tenn., steam heating manual arts building on the new Central High School grounds for $2,950.

J. J. Mulligan, Vicksburg, Miss., heating Speed Street School at Vicksburg for $1,475.

W. A. Patterson Co., Appleton, Wis., heating and ventilating system for High School building at Neenah, Wis., now used as the First Ward School. The plant will cost $3,700.

Cook & McDonnell, Oklahoma City, Okla., heating, ventilating and automatic temperature regulation for new high school building at Blackwell, Okla. The contract amounts to $4,700.

M. J. Daly & Sons, Waterbury, Conn., heating, plumbing and metal work in connection with alterations at the City Hall, for $5,699.

Pierce & Cox, Boston, Mass., heating and ventilating Quincy School, Boston, for $9,717. Other bidders were: J. J. Hurley & Co., $9,948; Commonwealth Heating Co., $10,497. James F. Dwyer, $10,800; Hern-Furlong Co., $10,088; C. H. Sanborn, $11,125; F. W. Zemier & Co., $10,096.

Stone, Underhill & Co., Boston, heating and ventilating new county court house in Quincy, Mass., for $3,250.

P. J. Gallagher, Faribault, Minn., heating and plumbing new post-office building in that city.

Faucett & Faucett, Preston, Minn., heating new school building at that point.

Chamberlin Metal Weather Strip Co., Detroit, Mich., has just completed an important contract in weather stripping the palace of Count Szechenyi at Budapest, Hungary. After investigating the merits of the Chamberlin equipment, the count, who married Miss Vanderbilt, of New York, had the Chamberlin system installed because of the fact that in the large rooms of the palace it would otherwise have been impossible to maintain even temperatures on account of the leakage of air around the windows. It was necessary on this contract to send workmen to Hungary from the company's New York office to do the installing.

Business Chances

Baltimore, Md.—C. Herbold & Sons have made application at the building inspector's office for a permit to begin work on 16 brick dwellings on North and Mingluff Avenues. Each house will be 14 x 59 ft. and will have steam heating plants. The total cost of the operation will be $28,000.

Peoria, Ill.—Hotchkiss & Harris, architects, are drawing plans for a central heating plant of the Tazewell County farm buildings. The heating plant will be of sufficient capacity to heat the present buildings as well as three new buildings for which the contract has recently been let.

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following-named work:

Until Sept. 15, 1911, for the mechanical equipment, excepting the elevators and mail handling apparatus, including plumbing, gas fitting, boiler plant, heating and ventilating system, conduit and wiring system, vacuum cleaning system, and induced draft system for the U. S. post office, Washington, D. C. Copies of the plans and specifications may be had in Washington or from D. H. Burnham & Co., Chicago, Ill., the architects of the building.

Tomah, Wis.—Robert M. Pringle, government adviser of the heating of buildings in the Indian service, will recommend an entirely new heating and ventilating plant for the buildings of the Indian School at Tomah.

THE HEATING AND VENTILATING MAGAZINE

1123 Broadway NEW YORK October, 1911

Ten Formulas for Figuring Radiation

An investigation set on foot by the National District Heating Association to learn the various methods in use by central station engineers for figuring both steam and hot water radiation has brought forth some unique rules which are as diversified as they are interesting. The formulas are here published for the first time, being included in a manuscript report of the association's committee on radiation.

In commenting on the formulas received, the chairman of the committee, W. K. Martin, of Crawfordsville, Ind., states that the methods of arriving at the necessary amount of radiation required to heat a building and maintain a certain temperature with a certain outside temperature and weather conditions fluctuating seem to be many and of different varieties, as he failed to find any two heating engineers or any two operating companies who use the same formula in arriving at a conclusion.

In applying the formulas here presented to a typical building requiring approximately 400 sq. ft. of radiation for steam and 700 sq. ft. for hot water, it was found that the estimates varied as much as 219 sq. ft. for steam and 120 sq. ft. for water. Each estimate, of course, was made for the same outside temperature and weather conditions.

Formula No. 1

For steam:

$$R = \frac{(C \times a) + (W \times b) + (G \times d)}{250}$$

For water:

$$R = \frac{(C \times a) + (W \times b) + (G \times d)}{100}$$

Where R = radiation.
C = cubic contents.
W = exposed wall.
G = glass (doors and windows).
a = cubic contents factor.
b = wall factor.
d = glass factor.

Factors:
For cubic contents, 1.4.
For exposed wall, 9-in., 24.
13-in., 21.
18-in., 17.
frame, 50.
best frame, 25.
For glass, plate, 40.
double, 60.
single, 80.

Formula No. 2

For hot water:

$$R = d75\left\{\frac{W - G}{h} - G\right\} + C$$

For steam: Divide result by 1.6.

Where R = radiation.
W = exposed wall.

G = glass (doors and windows).
C = cubic contents.
h = wall constant.
For 4-in. brick, 4.
For 9-in. brick, 5.
For 13-in. brick, 6.
For 17-in. brick, 7.
For 21-in. brick, 8.
For frame, 5.
d = temperature constant.
For 50° = 0.005.
For 60° = 0.007.
For 70° = 0.0082.
For 76° = 0.009.

For 10° F. below zero, add 10%.

Living rooms and reception halls to be maintained at 70° F.

Sleeping rooms, at 60° F.

Kitchens, at 60° F.

Bath rooms, at 75° F.

Formula No. 3

For hot water:

$$R = (0.005\ V + 0.05\ W + 0.5\ G)\ 1.87$$

For steam:

$$R = 0.005\ V + 0.05\ W + 0.5\ G$$

Where R = radiation.
V = cubic contents.
W = exposed wall.
G = glass (doors and windows).

Factors:
For cubic contents, 0.005.
For exposed wall, 0.05.
For glass, 0.5.

Formula No. 4

For steam:

$$R = G + (W + A) \times 75 + C \times B$$

Where R = radiation.
C = cubic contents.
W = exposed wall.
G = glass (doors and windows).

Factors for A:
8-in. brick wall, 8.
12-in. brick wall, 10.
16-in. brick wall, 12.
20-in. brick wall, 15.

Factors for B:
Steam at 2 lbs. gauge, 0.0055.
Water at 170° F. at radiator, 0.008.
Add 10% for 10° F. below zero.

Formula No. 5

For steam:

$$R = \frac{\left\{ G + \frac{W}{4} + \frac{C}{55} \times 2 \right\} \times d}{250}$$

Where R = radiation.
C = cubic contents.
W = exposed wall.
G = glass (doors and windows).
D = difference between inside and outside temperatures.

Factors:
For cubic contents, 0.04.
For exposed wall 0.25
For glass, Net.

Formula No. 6

For hot water:

$$R = \left\{ \frac{E}{T} + G \right\} \times 75 + C \div 10$$

Where R = radiation.
E = exposed wall.
G = glass and doors.
C = cubic contents.
T = ratio.
75 = constant.

Ratio for 9-in. brick wall, 8.
13-in. brick wall, 10.
18-in. brick wall, 12.
Frame, 8.

Formula No. 7

For steam at 2 lbs. gauge at service valve:

$$R = C + \left\{ G + \frac{W-G}{F} \times 75 \right\} \times 0.0055$$

Where R = radiation.
C = cubic contents.
W = exposed wall.
G = glass.
F = factor.

Factors:
For 9-in. brick wall, 10.
For 13-in. brick wall, 12.
For 18-in. brick wall, 15.
For frame, same as brick.
For plate glass, double and single glass, net.

Add 1% for each degree below zero.

Formula No. 8

$R = (C \times F) + (W \times F) + (G \times F)$

Where R = radiation.
C = cubic contents.
G = glass (doors and windows).
W = exposed wall.
F = factor.

Factors for steam:

For cubic contents,	0.006.
For exposed wall,	0.09.
For glass,	0.45.

Factors for hot water:

For cubic contents,	0.0085.
For exposed wall,	0.125.
For glass,	0.64.

Formula No. 9

For hot water:

$R = (C \times 0.0073) + (W - G \times F) + (G \times F)$

Water entering the building at 180° F. for zero outside.

Where R = radiation.
C = cubic contents.
W = exposed wall.
G = glass (doors and windows).
F = factor.

Factors:

For cubic contents,	0.0073.
For 9-in. brick wall.	0.12.
For 12-in. brick wall.	0.10.
For 18-in. brick wall.	0.10.
For frame construction.	0.14.
For plate glass,	0.5.
For double glass,	0.7.
For singie glass,	0.7.

Formula No. 10

$$R = 0.3 \left\{ \frac{C}{55} + G + \frac{W}{4} + \frac{B}{20} + \frac{A}{20} + \frac{O}{2} + \frac{I}{3} \right\}$$

Where R = radiation.
C = cubic contents.
G = glass.
W = exposed wall.
B = basement ceiling.
A = attic floor.
O = outside doors.
I = inside doors.

Factors: For cubic contents, 0.019 B. T. U. per cubic foot per degree difference in temperature per hour. Air change, one per hour.

Factors for walls and glass in B. T. U. per square foot per degree difference in temperature per hour:

For 9-in. brick wall,	0.44.
For 13-in. brick wall,	0.3.
For 18-in. brick wall,	0.24.
For frame construction,	0.25.
For plate glass,	0.75.
For double glass,	0.90.
For single glass,	1.03.

Additional data are being gathered by the association in an endeavor to compile a standard formula or set of formulas applicable to varying conditions.

Heating and Ventilating Equipment of the City Investing Building, New York

BY J. BYERS HOLBROOK

A comprehensive idea of the mechanical equipment required in a large office structure like the City Investing Building is to be had from the description of this plant prepared by one of the designing engineers and read at the recent meeting of the National District Heating Association.

As an office building, pure and simple, this structure Mr. Holbrook states is probably the largest of its kind in existence. It is located on the south side of Cortlandt street. between Broadway and Church street, New York, and grossly bulks up to approximately 10,250,000 cu. ft. of space. The main portion of the building is carried twenty-six stories, the tower or middle part being carried thirty-three stories, a total height above sidewalk of 470 feet.

The building is equipped with its own light and power plant, is heated on the two-pipe up-feed vacuum return system, has complete mechani-

cal exhaust ventilation for all toilet rooms throughout, a vacuum sweeper plant, motor generator service for office annunciators, etc., and contains generally all up-to-date devices which go to make up the ideal office building equipment.

The building is equipped with twenty-one standard plunger elevators. In compliance with the usual practice, the general power plant is located in the sub-basement. The total coal storage approximates 800 tons.

The boiler plant consists of four 400 H. P. and one 350 H. P. Babcock & Wilcox water tubular high pressure boilers, aggregating in all 1950 B. H. P. The coal (Buckwheat No. 2) is hand-fired and is burned by means of natural draft, furnished by a stack approximately 500 ft. high, continuing roughly 50 sq. ft. of net area. This stack is probably the highest stack in existence and not only handles the gases from its own plant, but also from the boiler plant of the Singer building immediately adjoining on the south. The Singer stack is carried up only fourteen stories, and to overcome the smoke, furnace gases, etc., wafted toward the City Investing Building, it was arranged by the various interests to make this connection. The possibility of such a future smoke connection was taken into account by the engineers and for this reason the City Investing stack was designed liberally for the additional load.

PUMPS

Two house pumps, each 14 x 20 x 10½ x 18, with a capacity of handling 1000 gallons per minute, are installed, beside one fire pump of a similar capacity. In addition to the elevator pumps, there are three boiler feed pumps installed, two 12 x 7½ x 10 and one 10 x 6 x 10. The latter pumps are of the duplex high pressure, outside packed type, and brass fitted throughout. For handling the returns from the heating system, two vacuum return pumps are installed in duplicate. Each pump is 10 x 16 x 16, brass lined. Tobin bronze piston rods and fitted with a special fibrous packing to resist boiling water.

GENERATING EQUIPMENT

This consists of four generating sets, three 300 K. W. each and one 150 K. W. units. The engines are of the tandem compound Corliss type, large units, 17 x 30 x 36, the small one being 12 x 22 x 30. The engines, of course, are run non-condensing, the exhaust from them and also from the pumping equipments, being used in the heating system and for heating the domestic hot water supply. The engines run at approximately a seed of 110 R. P. M. and are direct-connected to Westinghouse direct-current compound-wound generators.

POWER PIPING

The greater part of the high pressure piping is located in the boiler room, with a consequent minimum amount of piping being found in the general machinery room. The main steam header carried back of boilers is cross-connected to a second or auxiliary header, so that an elasticity of steam distribution is secured. High pressure leads are run from the boiler room headers through the intervening wall to the various engines, pumps and incidental apparatus requiring live steam.

A high pressure connection is made to the heating system for periods when there is an insufficiency of exhaust. Another high pressure connection is run to the riser carried in turn to the Luncheon Club Kitchen steam apparatus located on the twenty-sixth and twenty-seventh floors.

The exhaust steam from all engines, pumps, etc., is carried in trenched lines, all of which terminate in a 24-inch O. D. main connected to a combined muffler tank and grease extractor. This apparatus has a three-valved by-pass and beyond later a 10-in. exhaust connection is taken to a single leg or "dead end" Webster open feed

water heater. Beyond the above connection is located the back-pressure valve and from the latter the outboard exhaust is carried outside of the building and up along the smoke stack a distance of approximately 475 ft.

Emergency or non-return valves are installed in the high pressure piping at each boiler. Steam separators are provided in piping leads to engines, etc., and every provision has been made to drip all piping throughout. All clean drips are returned to the boilers by the Holly loop system.

The above general description will give one a fairly good idea of the size of this isolated plant. The building uses on an average of 150,000 to 160,000 K. W. hours per month, the daily coal consumption averaging from 18 to 20 tons (long). For the day period the boiler plant is handled by two firemen and one coal passer. The total water consumption for all purposes runs from 2,500,000 to 3,000,000 gals. per month.

HEATING EQUIPMENT

The heating, quite naturally in a building of this nature, is by direct radiation. It is installed on the two-pipe up-feed type, the exhaust steam being circulated throughout the general distributing system on a low vacuum. The Webster system of exhaust steam heating is employed, but the general installation is one of rather an unusual nature. The refinement consisted in combining with the above, the desirable features exploited by Charles A. Ball, and used by him on some very extensive heating systems employed in the Eastman Kodak Company's plants in Rochester, N. Y. The advantages secured in this combination system was the control of the vacuum. Considering the velocity of the downward flow of all condensation in a building of this height, it was designed to receive all main and steam riser condensation in a separate horizontal pipe, termed a "base" or sump line. This base line is so installed that it relieves to the sump, with a controling valve, for washout purposes and that upon the closing of the valve to sump, the condensation should seal and flood up to and overthrow into the feed-water heater. This provision simplifies and considerably reduces the work upon the vacuum pumps and consequently avoids the continued use of a jet to condense any re-evaporation (flashing) of this highly heated water at the pump.

A main return was installed to extend around the base of the plant, in manner very much similar to the "base" or sump line. This line receives all condensation from the radiation, coursing to the base of the plant, through the vertical return piping or return risers. The terminal of this main return connects to the section of the vacuum pumps, and is termed the main high vacuum line, for distinctions further on explained.

Seven separate parts or divisions termed "divisional units" were provided, one exclusively for the hot-blast apparatus, and the total aggregation of direct surface, divided as nearly equal as practicable, to form the other six divisional units.

A 1-in. vacuum controller was installed for each unit, so that just that degree of lesser vacuum could be maintained, necessary for a circulation in each unit, as related and distinguished from all other units.

A special vacuum trap is installed for each unit. This trap has a conical opening downward in the direction of the vacuum pull, with float regulation, discharging only that excess of water above the normal water line of trap. All traps are slightly elevated on foundations, so that a seal in the main return on the low vacuum side of the system is maintained equal to the distance from the inlet port of trap to the high vacuum line below.

The exhausting apparatus, as before referred to, consists of the two vacuum pumps set in relay and so

reciprocally piped and valved, that either pump can be run at will. The pumps run free and uncontrolled, as the controller permits any regulation needed for the lesser degree maintained in the several units. To reduce the amount of jet water (generally overflowing the feed water heater and wasting in many vacuum return systems), a surface condenser or small closed heater was installed to function reciprocally with either pump. A direct service city water main was diverted to the condenser, with a by-pass, the pipe continuing and connection being made to the suction port of the house pump, discharging to the house tanks located at the top of the building.

Owing to the great volume of this water service supply, it is not warmed more than a few degrees above the entering temperature. The condenser is a Wainwright, 100 H. P. feed water heater, placed horizontally between the two vacuum pumps, and so arranged that the condensation courses through the interior pipes or tubes, and the condensing water in the outer space, thus making a surface condenser with no waste of the condensing medium.

The hot blast apparatus has each section controlled by a swing check, closing the section against a back-lash or return of water to the section, due to the condensation vacuum when the steam valve will be closed. A reduced tee is installed beyond the check, on each separate return from the sections, and an air line with globe valve on each connects to the main air line, to which the controller is applied.

In this manner the lesser degree of vacuum maintained by the controller is further regulated for the requirements of the individual sections, as they are related to the incoming air, and consequent differing condensation volumes.

During temporary heat and be-before the building was completed, the Webster return water seal motor valves were installed without their interiors or floats. Steam was thus circulated through these full openings of all radiators to the branch and main return piping, thus securing a complete wash-out of all oil, lead chips, core sand and kindred sediment from the entire system of radiators and piping.

As the plant is run to-day the low speed of the vacuum pumps maintains approximately 13-in. to 16-in. vacuum at the pump, approximately 3-in. at each trap and a general circulation of approximately ¾-in. vacuum throughout the entire system.

The operation of the entire plant is in every way satisfactory and is probably one of the most economically operated office building plants in New York. The total equipment of direct radiation installed approximates 100,000 sq. ft. The heating system contains fifty sets of rising lines, most of which terminate at the twenty-sixth floor, thirteen sets being carried up to the thirty-second floor in the tower portion of the building. There is a total of approximately 2400 direct radiators, six indirect or reheater stacks used in conjunction with the heating of the Broadway entrance of the first floor large main hall and one hot blast or tempering coil employed for preheating the incoming air and safeguarding the air washer sprays from freezing.

The main Broadway entrance hall as above referred to is heated by direct radiators which are installed of the direct indirect type. From the general fresh air supply duct system in sub-basement a branch duct is taken to six reheater or indirect stacks located in sub-basement pressure tank, Broadway wing. From these stacks flues are run up to the hall direct radiators referred to above. This combined form of heating the large arcade insures a generous quantity of warm air and tends to overcome the cold drafts so prevalent in large entrance halls or corridors. The major heating mains (each

starting 14-in. O. D.) are run level without pitch, and drippage is secured by means of the turned down (45°) riser lateral connections. The base of each riser is carried down and dripped into the "base" or sump line. Stop valves on risers are installed above the tee connections to supply mains, thus insuring constant dripping of the latter at all times. All vertical lines, risers, etc., are fitted with double sets of brass sleeve expansion joints, installed generally on the seventh and sixteenth floors, the pipes being anchored at the third, twelfth and twenty-first floors.

All pipe used throughout is genuine wrought iron and for the low pressure mains, the connections and fittings 5 in. and larger are of the flanged type.

VENTILATION

The mechanical ventilation installed in this building is as follows:

Supply and exhaust ventilation for boiler, engine room and the general sub-basement quarters. Exhaust ventilation for the typical toilet rooms on all floors throughout. The supply ventilation for the sub-basement consists of a preheater coil for guarding the air washer sprays in freezing weather. This coil is automatically controlled by a system of temperature control. The remaining equipment consists of an air washer, for cleaning all incoming air (taken at sidewalk level on Cortlandt street), an electric 50 H. P. motor driven pressure fan having a wheel 10 ft. in diameter by a center width of 5 ft. 1 in. This fan supplies fresh air by means of a ramificated system of galvanized sheet metal ducts, which are carried in the hung ceiling to innumerable grilles, well located throughout engine and boiler rooms, so as to insure a good distribution of fresh air where most needed.

The exhaust ventilation for this floor emulates somewhat the supply, the grilles being well distributed and placed flush in the hung ceiling, where the warm air is collected. The exhaust ducts are also carried in this false ceiling space and terminate in an exhaust steel plate fan having a 10-ft. diameter blast wheel, the width of the latter being 4 ft. 3½ in. This fan is directly driven by a 40 H. P. electric motor. The foul and hot air handled by this exhaust fan is discharged in an upcast carried up in the easterly interior court. All supply drop connections in the boiler and engine rooms are carried down from the hung ceiling and to such heights above floors as to favor best the operating forces and, further, to prevent the short circuiting of fresh air to the exhaust openings. The exhaust ventilation for the two sets (east and west sides) of typical floor toilets is handled by 80-in. and 90-in. steel plate exhaust fans located in pent houses on the twenty-seventh floor level. The latter fans are directly driven by electric motors.

Edward Baxter is the superintendent and operating engineer in charge of the entire equipments. Francis H. Kimball was the architect of the building, and Griggs and Holbrook acted in the capacity of consulting, designing and supervising engineers for the mechanical and electrical plants.

Car Ventilation

A DISCUSSION OF A PAPER ON THIS SUBJECT, READ BEFORE THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS*

PRESIDENT BOLTON: This paper, if it did nothing else, would show that the public has reached the point of taking an interest in the great subject of ventilation, because it is only by means of public demands that railroad companies will go to the expense of even testing or trying out ventilating systems.

In the New York City subway, I believe I am justified in asserting that the average space occupied by a passenger in the rush hours does not exceed 80 cu. ft. It is easy to see how soon a restricted space such as that will become foul. To afford the amount of air required by the Chicago ordinance, or 350 cu. ft. per passenger, would effect about four changes of air in such a crowded car per hour, which is a very moderate amount of ventilation under such circumstances.

Some of the New York subway cars

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recently have been equipped with vertical agitator fans, four in each car, suspended from the ceiling. They are wide-bladed, slow-speed disc fans, with direct-connected motors. They produce a pleasant down-draft and agitation of the air in the car and are effective in minimizing the heat and pollution of the air of the car and of the subway.

MR. NATKIN: I had occasion to discuss this subject with an engineer employed by the Chicago elevated railroad. It had been the custom to run four- or five-car trains, carrying a smoker as the last car. This engineer made a number of tests for carbon dioxide on various cars, particularly on the express service. For a distance of five miles, where the running time is 11 minutes, he found that the carbon dioxide increased about 1% in all cars except smokers, where it increased 200% or 300%. The reason for placing the smoker at the rear was to prevent the smoke from entering the other cars. They then tried the experiment of running the smoker as the first car, figuring that it would thus have more ventilation, due to the speed of the train. They found that arrangement reduced the carbon dioxide materially.

The Forthcoming Federal System of Heating and Ventilating

An idea of what heating engineers may expect to find in the forthcoming publication of warm air furnace ratings and the Federal system of heating and ventilation, soon to be issued by the Federal Furnace League, is given in an address made at the recent convention of sheet metal contractors at Omaha, Neb., by Dr. W. F. Colbert, the engineer of the league.

Dr. Colbert said that when the full furnace ratings were published and with the Federal system of heating and ventilation at hand, it will be possible to calculate the sizes of warm air pipes and registers, vent ducts and registers, fresh air duct, fresh air room and fresh air intake window, ventilating shaft, chimney and furnace in an average time of 2 minutes per room, after the measurements have been taken from the plans. At that rate, the figures for an 8- or 9-room house, with bath, could be set out in approximately 15 minutes.

This simplification of estimating methods has been devised on account of the impossibility of a dealer's spending the necessary time to experiment on the heat losses through glass and walls under varying wind and temperature conditions. Yet, heretofore, that is the only way he could secure the information, because all the heat loss data in text-books is based on laboratory experiments in still air, and still air never occurs outdoors.

Speaking further of the present difficulties in the way of properly designing warm air furnace systems, Dr. Colbert said that after the heat losses are procured, it is necessary, under present conditions, to determine the register temperature of the warm air in zero weather and to calculate therefrom how many B. T. U. would be available, from each cubic foot of warm air delivered into the room, for offsetting the heat losses. It is also necessary to determine the average velocity of the flow of air through the pipes to the first, second and third floor rooms and the differences in the percentage of friction in the various sizes of pipes. Then special inquiry has to be made concerning the actual percentage of free air space in register faces and the percentage of friction that would be allowed, because the air is divided into very small columns instead of coming through the register as it comes through the warm air pipe, in one large column.

With this information at hand, it is possible to find the size of heat pipe and register required to heat the room

after an hour of hard work. This operation has to be repeated for every room to be heated and every ventilating or air circulating duct.

Then it is necessary to add together the B. T. U. heat losses from all the rooms to be heated, plus a percentage for heat losses in cellar piping and to determine the size of furnace required. Here is the difficulty, for up to the present time no furnace is rated in British thermal units.

Dr. Colbert added that he knew it is quite common to allow 8,000 B. T. U. for every pound of coal burned per hour and to allow from 4 to 6 lbs. of coal per square foot of grate surface, but he stated that in the tests conducted by the Federal Furnace League, it was found that the B. T. U. delivery from a pound of coal showed a variation of 30% in one series of furnaces and there is a difference of about 40% between the best furnace and the poorest furnace tested to date. In addition to these variations, the league has found many differences between the published size of fire-pot and the actual size, amounting, in some cases, to as much as 2 in., and it was also found that the fire-pots are just as likely to be larger than the published size as they are to be smaller. In fact, it was quite common to find variations both ways in one series of furnaces.

Then, after making more or less of a guess at the size of furnace required to heat the building, it has been necessary to determine the proper size of fresh air duct, fresh air room and fresh air window, for more than one otherwise good installation has been ruined by a fresh air intake window that is entirely too small. Moreover, if a ventilating system is included with the heating plant, it has been necessary to make complicated calculations to determine the proper size of main vent shafts.

According to the forthcoming Federal system, there are only a few calculations for each room, in such small numbers that, with a little practice, they can be done by mental arithmetic. Then the heat losses from all the rooms to be heated is totalled up by adding the line of figures. After that is done, it only remains to refer to the printed tables, included in the League's system, for the sizes of everything needed to lay out a complete job and then to look in a furnace catalogue for the number of the furnace required.

150 MORE FURNACES TO BE RATED

In connection with the work of testing warm air furnaces, which has been under way for over a year at the League's Philadelphia testing plant, Dr. Colbert stated that before closing down for the summer, completed rating tests had been made on 38 furnaces from eight manufacturers. From these test results and the measurements of the other sizes of the same series, taken since the tests were made, it will be possible to rate more than 80 furnaces in the 17 series represented. The league has at the testing station or has promised for immediate shipment about 60 furnaces from nine other manufacturers. From the tests on these furnaces the league will be able to rate about 150 furnaces in the 27 series represented.

The furnace testing, Dr. Colbert stated, is undoubtedly going to stimulate interest in furnace design. At this early date several of the members are at work making more or less important changes in the furnaces tested. Two of them are at work on entirely new designs, with the idea of surpassing the results obtained in the tests on their present lines of furnaces. There are others whose furnaces are listed for tests who have stated their intention to try to improve their furnaces as soon as complete reports are in their hands. This promises well for the development of better furnaces.

There can be but one conclusion, said Dr. Colbert, from the league's experience to date; that is, that united effort on the part of manufacturers of and retail dealers in warm air furnaces will surely result in making furnace heating, with ventilation, as fashionable and profitable as hot water heating was ten years ago.

Ventilation for a Compact Theatre Building

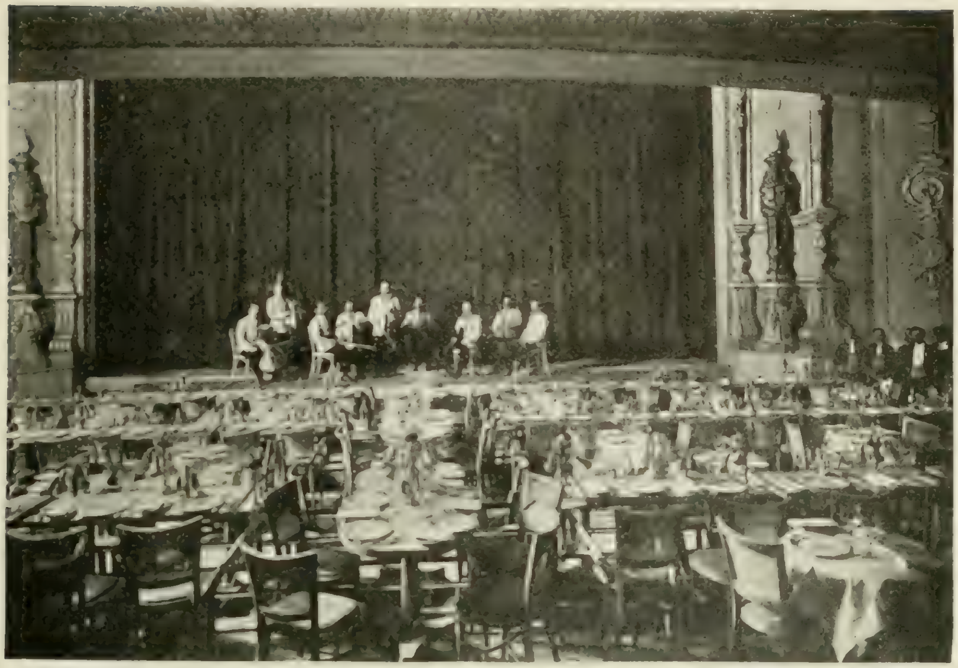
MECHANICAL EQUIPMENT OF THE FOLIES BERGERE, NEW YORK'S NEW TYPE PLAYHOUSE

As severe a test of modern ventilation methods as one is likely to find has been successfully met in the case of the Folies Bergere, on Forty-sixth street, near Broadway, New York. This unique playhouse is not only compact to a degree but has facilities for serving warm meals, both in the body of the theatre and in the first balcony, during the progress of the play. The kitchen, moreover, is directly under the orchestra, so that the ventilation problem includes not only the freshening of the air supply but also the elimination of all cooking odors and excessive heat from the ranges. The satisfactory solution of this problem lends unusual interest to the methods employed which are a striking proof of the efficiency of present practice under extremely trying conditions, for the management states that the air at all times is both fresh and odorless.

Courtesy of Architecture and Building

FOLIES BERGERE, NEW YORK

The mechanical equipment of the theatre includes a refrigerating plant and a sprinkler system, but the present



Courtesy of Architecture and Building

ORCHESTRA DINING TABLES FOLIES BERGERE

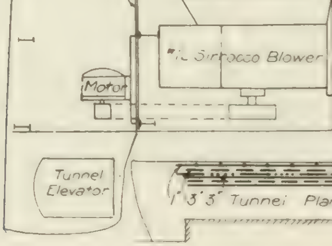
Courtesy of Architecture and Building

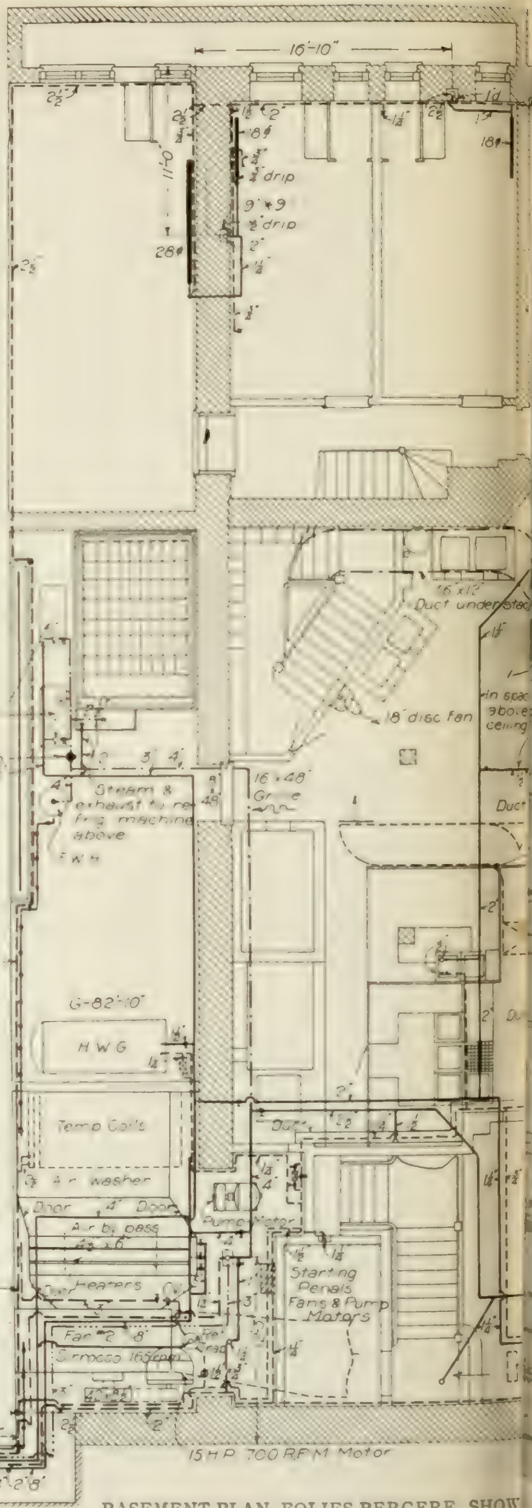
KITCHEN OF FOLIES BERGERE, NEW YORK, SHOWING STEAM CONNECTIONS TO RANGES

article will be confined to a description of the heating, air supply and ventilating apparatus. The building is heated by a fan system throughout, supplemented by direct radiation through the stage portions, lobbies and certain other places. The air supply is taken through louvres in an area near the street level, drawn through heaters and air washers and then through a fan and discharged through ducts to the various portions of the house. Ventilation is secured by means of disc fans pulling from the various sections and discharging at different levels.

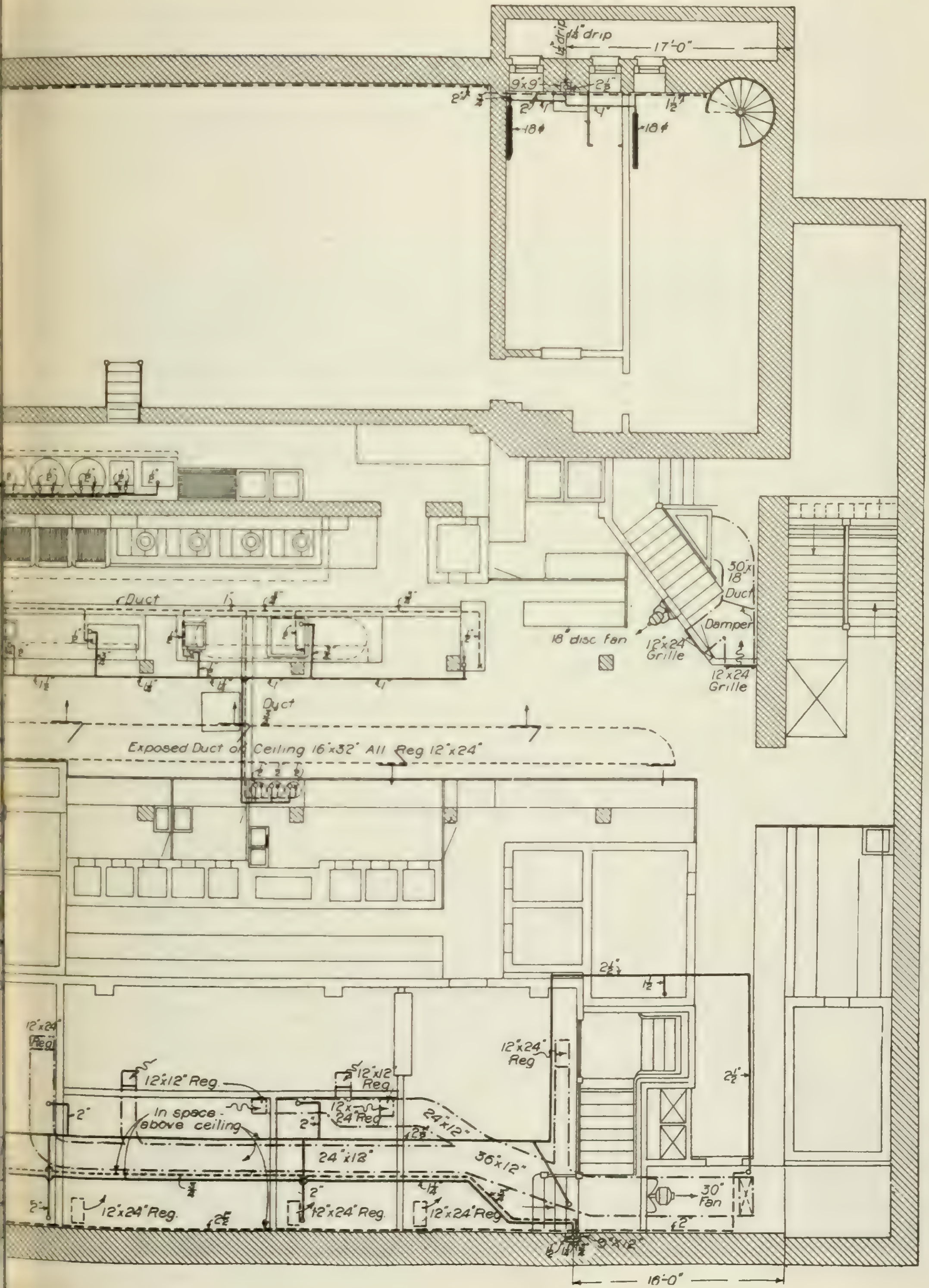
The air washer, which is of the Acme type, is the first to be installed in a theatre in New York. It is used not only to eliminate the dirt and dust which might settle on the light fabrics on the tables and accessories, but also to cool the air in summer, so that the theatre may be run continuously throughout the year. On the warmest days during the past summer the air washer was able to keep the auditorium 10° to 12° F. cooler than the outside air.

An important advantage was gained at the outset through arrangements for taking the steam required for operating the various pieces of apparatus requiring steam from the boilers in the Gaiety Theatre, next door, obviating the necessity of crowding boilers in the restricted basement space. The boilers and piping in the Gaiety Theatre were remodeled to take care of the new conditions. The returns, there-





BASEMENT PLAN, FOLIES BERGERE, SHOW

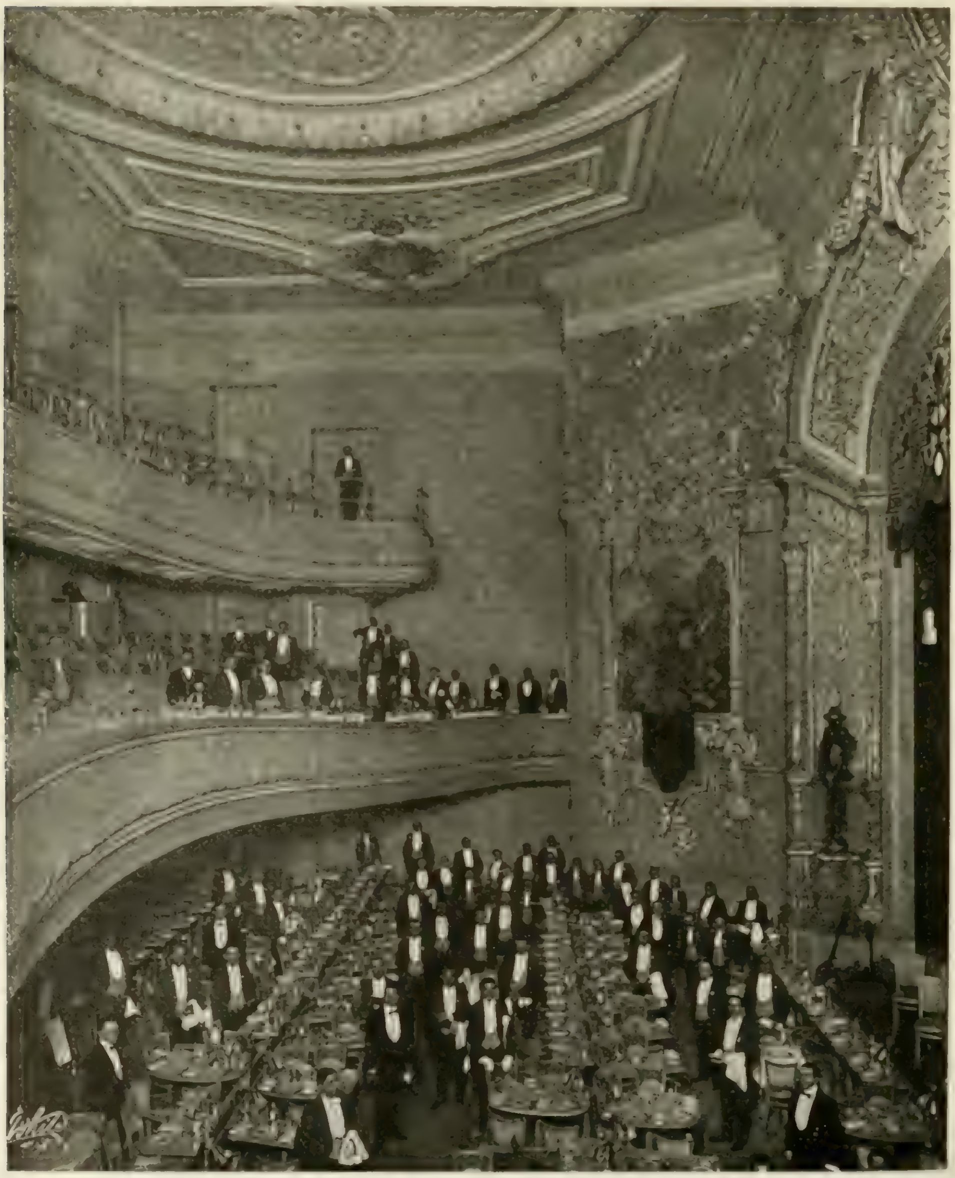


MECHANICAL PLANT AND ARRANGEMENTS FOR SUPPLYING AND EXHAUSTING AIR FROM KITCHEN

fore, from the entire system are carried back into the receiver in the adjoining building.

Into this receiver are also returned the vacuum returns from the Gaiety Theatre building; the Folies Bergere building being run as a gravity downfeed system.

The piping on the boilers in the Gaiety Theatre building was entirely remodelled; the two boilers being made into high-pressure boilers, having an allowable working pressure of 60 lbs. Steam for heating the Gaiety Theatre and Folies Bergere was taken through separate pressure-reducing valves into the heating system in each building; and a high-pressure line was taken from the boiler header into a specially constructed separator before it was

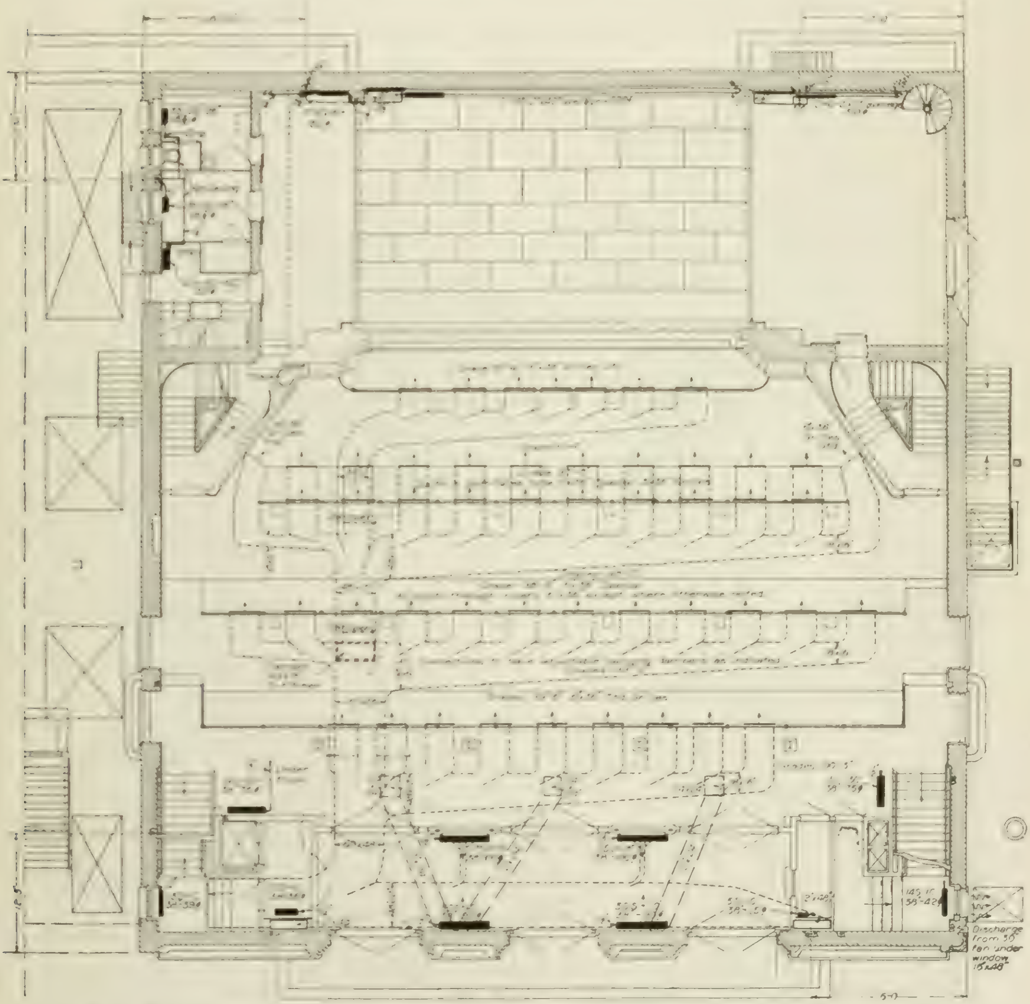


Courtesy of Architecture and Building

GENERAL VIEW OF AUDITORIUM, FOLIES BERGERE, NEW YORK

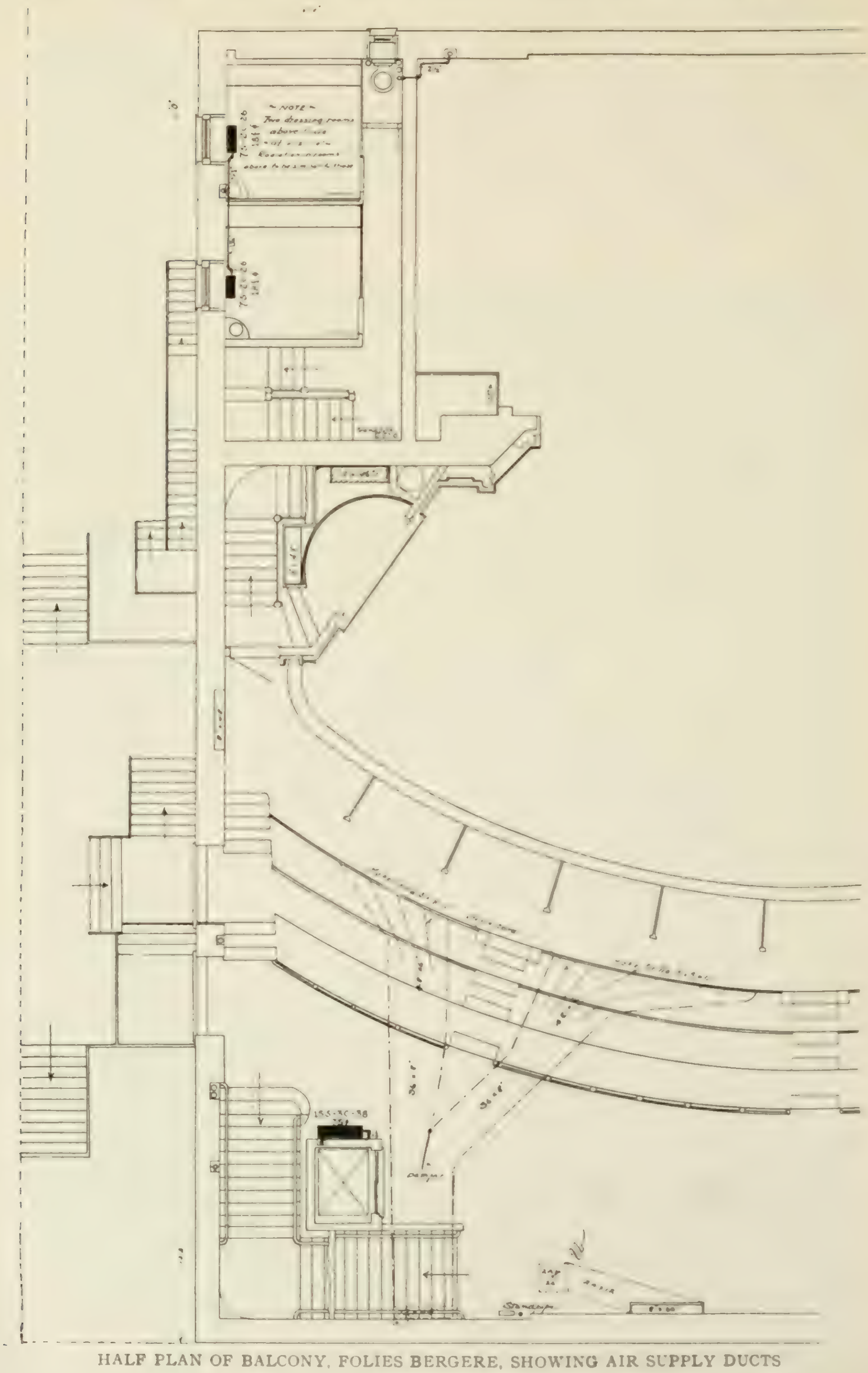
continued into the high-pressure apparatus. This separator was deemed necessary because the boilers, being originally intended for low-pressure work, had small steam spaces, and it was thought that they might prime if forced; consequently, a special separator was installed, not only to remove the water that might be carried off, but actually to act as an auxiliary steam space. The high-pressure line then continues into the refrigerating apparatus, two brine pumps, the kitchen apparatus, and hot-water generator.

A line was also carried up to the top floor, on which a buffet pantry was to have been fitted up. This high-pressure line was also connected into the torch line on the roof, in case the exhaust steam was not sufficient to operate these torches. Each kitchen fixture has a separate valve on the supply and a check valve on the return. One main valve controls the supply and the returns for the entire kitchen fixtures are returned through a valved trap into the returns. All returns discharge into the main return, going back to the return tank, the returns from the kitchen apparatus being run in trenches.

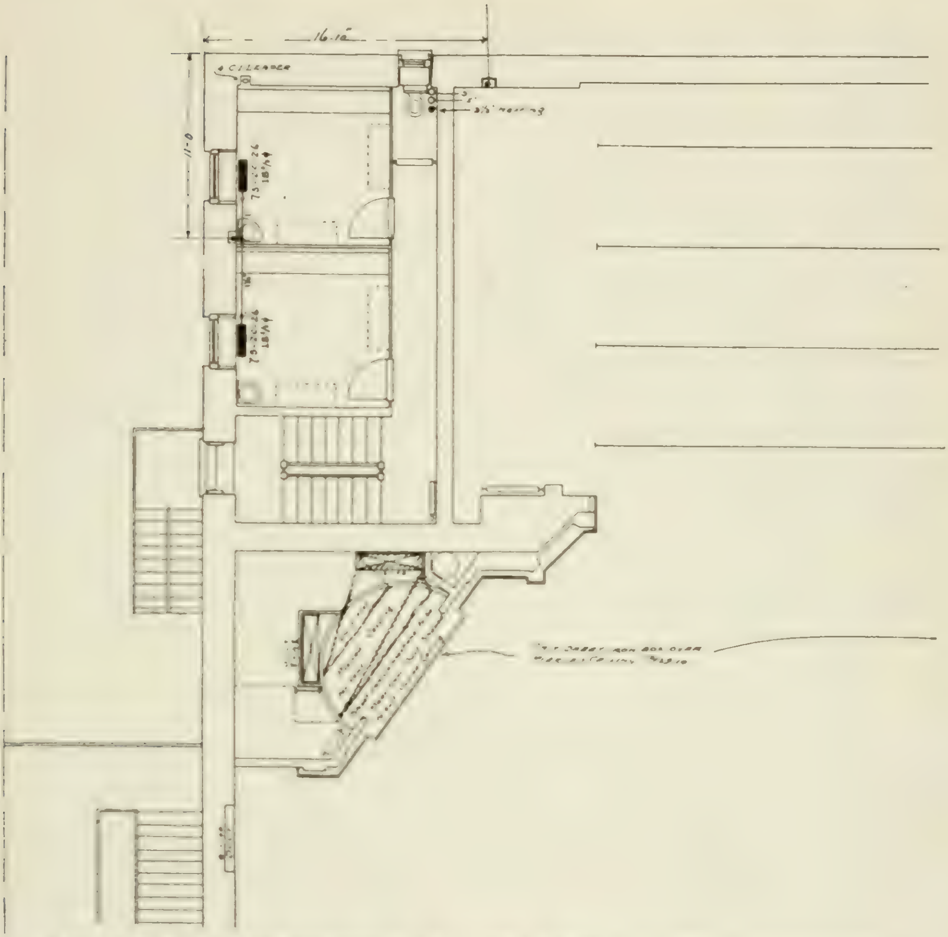


FIRST FLOOR PLAN, FOLIES BERGERE, SHOWING AIR DISTRIBUTION TO ORCHESTRA

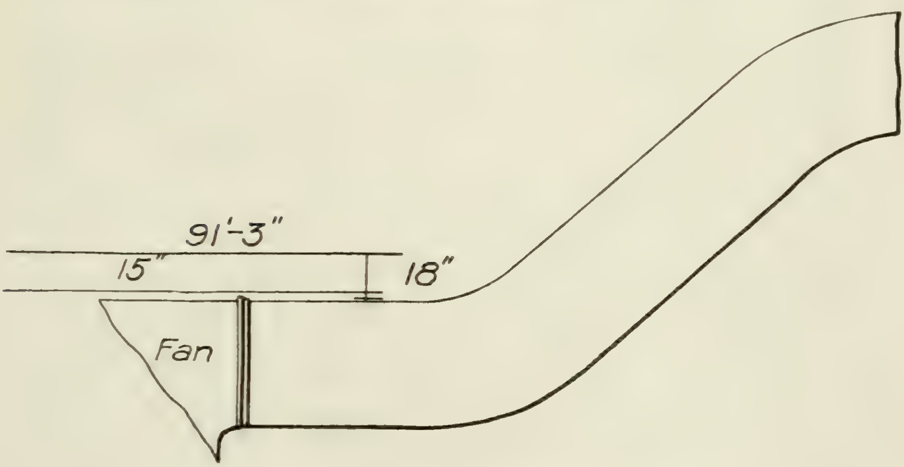
The exhaust piping from the brine pumps and compressor is carried



HALF PLAN OF BALCONY, FOLIES BERGERE, SHOWING AIR SUPPLY DUCTS



PART PLAN OF FOLIES BERGERE AT GALLERY LEVEL, SHOWING ARRANGEMENTS OF VENT DUCTS

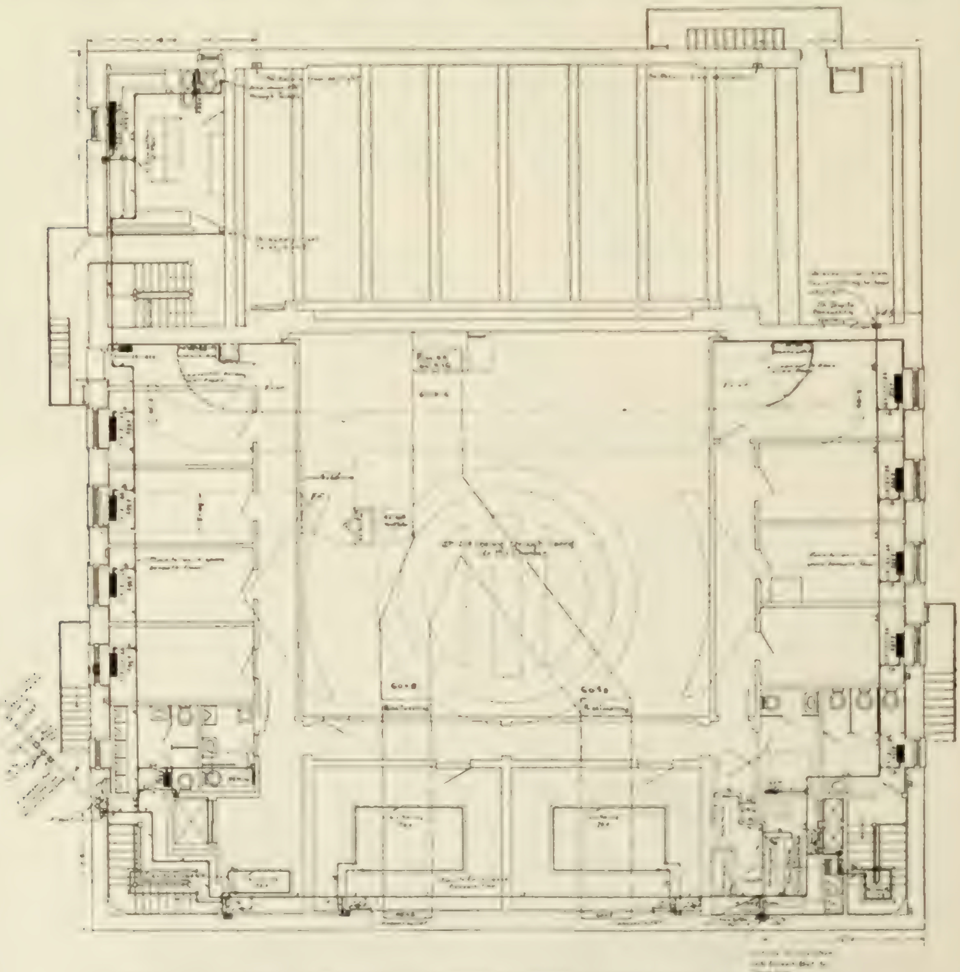


DETAIL OF AIR DUCT LEADING TO FIRST FLOOR

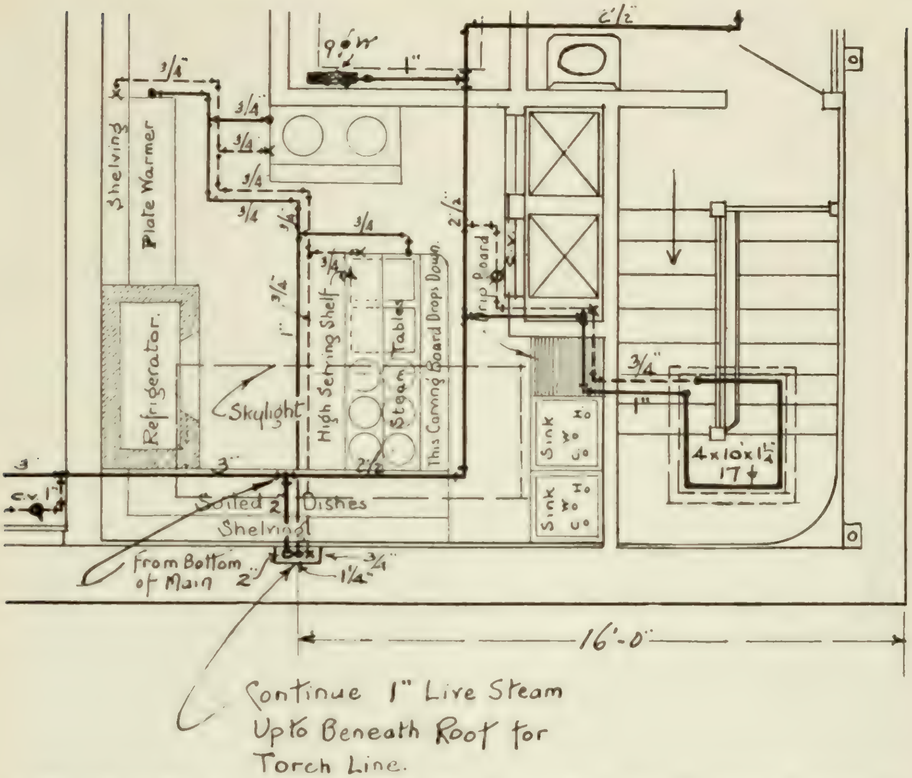
through a feed water heater of the Berryman type, and then back into the main exhaust system, for supplying steam for heating purposes; and also through a 4-in. riser to the roof, where this riser is capped with an exhaust head, below which is the back-pressure valve. Below the back-pressure valve connections are taken off and carried around the front of the building, and perforated outlets made in back of each torch in front of the building. This torch line is supplemented by means of the high-pressure line, brought up for the buffet pantry, as previously mentioned.

The air supply and ventilation constituted the most intricate problem confronting the engineers. On account of the large amount of heat and smell from the food it was necessary to provide more fresh air and more ventilation than ordinarily would have been required.

The fresh air for the building is brought in from the court, through a stack of Vento cast-iron hot-blast heaters, two sections deep, controlled by a thermostat working from the cold air inlet. The air is carried through a Thomas Acme air washer, which has a capacity of 40,000 cu. ft. of air per minute, and which is constructed with an extra row of spray nozzles for additional cooling effect in the summer. The air is then carried through three sections of Vento hot-blast heaters, controlled by a thermostat, working



LOFT PLAN, FOLIES BERGERE, SHOWING VENT DUCTS FOR AUDITORIUM, AND STEAM CONNECTIONS FOR BUFFET PANTRY



DETAIL OF STEAM CONNECTION TO BUFFET PANTRY IN LOFT OF FOLIES BERGERE

from the auditorium, and then through a No. 12 Sirocco fan, driven by a 15 H. P. Sprague belted motor. The air is discharged through ducts and flues to the various parts of the auditorium, the balcony, and boxes, and a separate duct to the kitchen.

It is so arranged that the air changes in the kitchen shall be at the rate of about ten changes an hour, and five changes an hour in the auditorium, when the fan is run at 175 R. P. M.

All of the air in the auditorium comes in at the floor level, and all the exhausting of the air takes place at the ceiling, so that the smoke and odors will rise quickly, and no smoke shall interfere with the view of the stage.

The venting of the auditorium is accomplished by means of a 72-in. belt-driven disc fan, located in a house specifically constructed for it on the roof, and connected by means of openings and ducts to the chamber over the auditorium. The toilets and cloak rooms are separately vented by means of a 30-in. disc fan discharging into the west court.

The kitchen is independently vented by means of a 42-in. disc fan located in an air-tight chamber over the auditorium ceiling, and then discharging to the roof. This fan is connected by means of vertical flues and ducts to a vent duct over the range hoods, and to all register openings in both the stairs to the kitchen, to prevent any possibility of smells arising from the kitchen into the auditorium. A fan was placed in each wall of the stairways leading to the auditorium from the kitchen, these fans discharging back into the kitchen. This arrangement proved most successful in preventing any smells of any kind arising through the stairways.

The architects of the Folies Bergere Theatre are Herts & Tallant, New York. The entire mechanical equipment was designed and installed by Francis Bros. & Jellett, Philadelphia and New York.

The Problem of Sub-Basement Ventilation

A paper by D. M. Quay on the ventilation of the Macy department store in New York, which was read at the recent summer meeting of the heating engineers, brought out a discussion of the difficulties of sub-basement ventilation, together with some useful hints for reducing the excessive temperatures in engine and boiler rooms. James H. Davis stated that in Chicago there is considerable discussion going on over this matter between the contractors and the city authorities. In one hotel, he said, it had been planned to arrange sleeping quarters for the engineers and some of the help in the sub-basement. The authorities would not permit it, although it was shown that sufficient ventilation would be provided.

Mr. L. C. Soule: There is one plant in Chicago where the basement ventilation of a department store is accomplished by introducing all the fresh air on one side, blowing same across the room and exhausting it on the other side. It seems to me that if the right proportions are used, that is a very good method. The intakes and exhausts are located well up on the walls, near the ceiling. The room is about 60 feet wide.

Prof. John R. Allen: There is one difficulty I sometimes meet with in sub-basement ventilation, particularly in one case I have in mind, in which the difficulty was due to the fact that the air increased in temperature after passing any considerable distance into the room. When we first made this installation we found that taking the air in at the ceiling, with its temperature at 65°, and then letting it pass the full length of the room and exhausting it from the kitchen, say, a distance of 75 ft., the temperature of the air was increased 5° or 6°—in extreme cases as much as 8°. We had to make a change in our plant and introduce air at the opposite end of the room in order to keep down the temperature.

President Bolton: The removal of heat in the engine and boiler rooms presents peculiarly variable problems. The introduction of air under pressure into engine rooms as a means of ventilation is of little value, as the cool air becomes heated almost immediately, and such a supply must be supplemented by large venting or exhausting apparatus. I had to ventilate an engine room in a large hotel in New York in which the temperature in the summer-time was as high as 145°, and brought it down to 110° by reversing the supply fan and using it as an exhauster, when the fresh air readily found its way in through the opening from the exterior atmosphere. The main thing is to get the heated or expanded air out of the room and then allow fresh air to find its own way in.

Mr. Soule: In one boiler room in Chicago the heated air is carried from the tops of the boilers through ducts and forced by fans under the boilers, where it is discharged through Jones stokers. That is a very good method of decreasing the temperature of the air so that it will not affect the first floor. Of course, there was a separate fan supplying fresh air for the men. The travel of this air was across the room.

Ventilators on Bottoms of Cars

"In Chicago the elevated railway company," says Mr. Benj. Natkin, "has now provided ventilators on the bottom of the cars—a V-shaped projector, five being placed on each car. By running the smoker ahead, and with the assistance of these ventilators, the air is not at all objectionable, the increase of CO_2 being not over 50% more than when the car is empty. I might add that the cars are of the open-platform type and the doors were kept closed. Practically all of those new cars have been built by the Pullman Company, principally for the Twelfth street line, which is patronized largely by laborers. I had occasion to ride on that line when the old cars were running, and you can readily notice the difference in the air with the new cars. While the air now is not as pure as on some of our other lines, there is a great improvement."

So-Called Superiority of Exhaust Steam Over Live Steam for Heating

A further expression of views on the part of heating engineers as to the comparative efficiency of exhaust and live steam for heating purposes was given at the recent heating engineers' meeting in Chicago in connection with a special topic on the subject.

Prof. J. D. Hoffman said he thought this was a case where a general statement has been based on local conditions. "You cannot get something for nothing in this world," he added. "If you take live steam into an engine cylinder, that live steam having 1,000 or 1,200 B. T. U. in it, or dry steam, and put it through the cylinder, doing work as it passes through, it comes out as exhaust steam, with less heat in it than when it went in. I do not see any other way out of it. Now, if it has less heat in it when it comes out there is less heating capacity."

President Bolton: I have never seen definite results evidencing superiority in exhausted steam for heating purposes, and I fail to see how it can afford more heat than live steam. It is probable that, in some cases, particular conditions have obtained in which exhausted steam has been so connected to a heating system as to inject itself through the system in a better manner than would take place with live steam through the reducing valve, and in that way a better circulation may have been attained, which has led to the idea that the result was due to superior value of exhausted steam. I have seen live steam connections made into exhaust steam heating systems in such a defective way that it has placed the live steam supply at a disadvantage. While exhaust steam was injected directly into the system, the live steam supply was injected at right-angles, and, in some cases, the reducing valve was too small, and, in other cases, the live steam supply had to follow tortuous passages and bends to get to the heating system.

Mr. W. M. Mackay: In following up the argument that has come to us from time to time, I believe the statement has been made largely by men who advocate vacuum systems of heating, their claim being that the lower the temperature of the heating medium or steam, the greater its heating efficiency.

President Bolton: In discussing this matter with some very ardent advocates of the superiority of exhausted steam, I suggested that it might be possible that moisture-laden steam would have a better effect inside of a radiator than the dry steam. A radiator has a very moderate amount of interior cubical space, while it has a large amount of thin surface exposed, and moisture in the steam might gather on the interior surface and afford a better means of conveying heat to the surface than the dry or superheated steam in contact with that surface.

Mr. Gifford: While it may be illogical and, theoretically, it is absolutely impossible, nevertheless I believe that, practically, exhaust steam goes further in heating effect than live steam. There are numerous buildings where the use of the engine as a reducing valve enables them to be heated at a lower fuel expense than when live steam is used through the ordinary reducing valve. I think the problem lies in connection with the relative amount of moisture in the steam.

In one installation in the plant of Louis Hance & Co., in Chicago, the building was entirely enclosed by December, and the janitor started up the heating plant prior to the installation of the engine. The boiler plant and the vacuum heating system were complete. The boiler capacity was greatly in excess of what the heating system should condense in heating that building, but the building would not heat, and the vacuum heating system was, of course, held responsible for it. All we could say was: "Wait till the engine is connected up and you will see the exhaust steam going to waste." That came to pass.

In this connection, I believe the proper connection for the live steam

through a reducing valve is in the top of the feed water heater and not in the usual place, so that the live steam, when delivered there, can pick up the necessary or proper amount of moisture.

PRESIDENT BOLTON: I have heard of a system installed in New York City in which the return water is bled into the steam supply pipe with the idea that the steam will absorb some of the moisture as it passes along, and have been told that this arrangement will be tried out this winter, to see if the humidifying effects of superheated steam has any effect on the interior surface of the radiator. That alone can explain any proven superiority, if such exists, because there is no more actual heat in exhaust steam, but less, than live steam.

PROF. JOHN R. ALLEN: I think there is no question but that moist steam carries heat better than live steam. In my experience, superheated steam is a very poor conductor of heat. Superheated steam is very dry. When you increase its moisture you increase its power of conduction. That is very well shown in the steam engine. If you take any ordinary engine and have it operated so as to have dry steam at the exhaust, you will get less condensation on account of less heat transmission to the cylinder walls. It has the same effect in radiators. If our steam is moist we will get a much greater heat transmission to the wall than with a dry steam. How we can get any greater amount than the total amount of the heat is, of course, a question.

MR. J. F. HALE: Some years ago there was a plant installed in a building with which I am familiar. Low-pressure boilers were used for heating the building, and it was specified that steam should be taken direct from the boilers without a reducing valve direct into the heating apparatus at 5 lbs. pressure. There was a vacuum heating system attached and it was impossible to get satisfactory results. The steam would not carry into the far points. The company whose apparatus was installed insisted that the reducing valve should be used in order to remove the moisture that was being carried directly from the surface of the water into the heating mains, and at their own expense they made a careful calorimeter test of the steam under both conditions. They found that when passing steam through the reducing valve a superheated condition prevailed in the steam and the building was heated successfully, whereas when the reducing valve was cut out, and steam at 5-lbs. pressure was admitted direct from the boiler into the heating main, the percentage of moisture was so great that the steam would not carry it to the far points.

MR. GIFFORD: I have frequently seen the same condition, due to the lifting of water out of the boiler into the mains to such an extent as to cut off the flow of steam to the far points. Water lifting may have been the trouble in the plant referred to by Mr. Hale.

MR. HALE: Before that test was made we put a steam separator on the line and removed, as far as possible, the moisture that was carried up from the boiler with the steam and that did not seem to improve conditions at all.

PROF. HOFFMAN: Was not that steam superheated after it passed through the reducing valve?

MR. HALE: That was exactly the condition.

MR. J. H. DAVIS: There is 25% less fuel used under conditions of reduced steam pressure. When the plant referred to by Mr. Hale was run under a pressure of 5 lbs. the pumps would scarcely handle the water of condensation. They were run by steam from a separate boiler. The boilers were run at 60 lbs. pressure, and after the reducing valve was placed on the heating main one pump was ample to take care of the condensation.

The Amount of Solid Material Extracted by Air Washers

One of the topics discussed at the recent heating engineers' meeting in

Chicago was the amount of solid material, dust and dirt extracted by air-washing apparatus in various cities, say, per 1,000,000 cu. ft. of air treated. Speaking on this topic, Mr. Thomas, of Thomas & Smith, manufacturers of the Acme air washer, said: "With a perfect air washing apparatus we can extract 99% of the solid material from the air. Different localities in the same city will have different quantities of solid matter in the air. I do not think I would care to make an offhand statement as to the weight of solid matter taken out of the air in different cities. Here in Chicago we are taking out as much as 60 lbs. of solid matter in 72 hours with a 40,000-ft. air washer on a 10-hour run. That is about as close an observation as I have made regarding the actual weight of material extracted. But we have made many tests as to the percentage of solid matter taken out of air by air washers and that will vary anywhere from 95% to 99%, and we have had as good as $99\frac{3}{5}\%$.

President Bolton: Do you determine the percentage by analysis of the air?

Mr. Thomas: Yes.

President Bolton: In Chicago, is the nature of that material a dust or is it carbon?

Mr. Thomas: It is carbon dust and a mixture of other things. In some localities you will find coffee and peanut scale and other matter blown out in the process of preparing foodstuffs and manufactured products. That all gets into the air and finds its way into the ventilating apparatus. But about half of the dirt is carbon.

President Bolton: Can you remove the smoke from the air within 5%?

Mr. Thomas: No, that cannot be done. We can get within about 20% of all the smoke. In other words, you can get about 70% of the carbon out of the smoke, but no more unless you had a device of prohibitive dimensions and an excessive water supply.

President Bolton: Can you tell us anything about the elimination of smells with air washers?

Mr. Thomas: There are very few smells that will not be dissipated by an air washer. If the air is overcharged with sulphur, you will get a trace of the sulphur. That can be removed by putting a chemical solution in the machine, using soda ash or something of that kind. Outside of sulphur, there are very few odors that get through. In the stockyards, for instance, when you go into Swift's office building, there is no trace there of the odors in the yards, but as soon as you leave the building the odors are decidedly noticeable.

Mr. Natkin: In the Armour office building, at the stockyards, the air washers, I believe, are of 40,000 cu. ft. capacity, the tank floor containing 40 sq. ft. They removed, in the summer time, 2 in. of dirt from that floor every day with the apparatus running for 12 or 14 hours a day. Odors are almost entirely eliminated. In summer, of course, there is more dirt to be removed than in winter, as we have the dust in the air in addition to the smoke and other particles.

Problems in Connection with Boiler Rating

We present herewith extracts from the discussion of Frank L. Busey's paper on the subject of boiler and furnace ratings which was read at the recent summer meeting of the heating engineers and which appeared in The Heating and Ventilating Magazine for July:

Prof. Allen: In determining his results, I would ask Mr. Busey if he could distinguish between the fire surface and the flue surface of the boilers tested?

Mr. Busey: No. I took the total heating surface. That would make some difference, although I have not been able to determine just how much. It is very difficult at best to ascertain what the various manufacturers call direct and indirect heating surface. I might measure up a boiler and call some of the surface direct, though the manufacturers might call a little more of it direct. As far as I can determine, basing estimates upon the total

heating surface regardless of the ratio of direct to indirect surface, has not made any serious difference in the results.

PROF. ALLEN: Do you not think there is a marked difference between the fire surface and the fuel surface?

MR. BUSEY: There is, yes, but with any ordinary variation in their ratio the efficiency is not greatly affected.

PROF. ALLEN: I can always distinguish this difference. In a power boiler, the gas is always dynamic and in a heating boiler it is static.

MR. BUSEY: That is true when you put on extra indirect surface and the passes are tortuous and more or less restricted. They soon fill up with soot, choking the draft. This is shown when anthracite coal is burned. In that case, with the addition of more indirect surface, the greater the ratio of heating surface to grate, the greater the effect while, with bituminous, the effects are noticeably less.

PROF. ALLEN: To give your charts universal application, you would have to know the proportions of fire surface and flue surface or else develop a curve for a particular boiler, would you not?

MR. BUSEY: I hardly think so. I have been able to obtain the results of a good many tests, and in plotting them it surprised me to see how close they came to each other, irrespective of how much direct or indirect surface there was and irrespective of the shape of the boilers.

MR. W. M. MACKAY: I think it is quite remarkable that we do get that straight line relation between the ratio of grate surface and heating surface and it seems to me that if it is based on a large number of observations, it practically overcomes the obstacle of the necessity of knowing the relative amounts of fire and flue surfaces.

I believe the basis of rating is relatively unimportant; that is, we do not need to rate a boiler in terms of horsepower, because that, after all, is a definite number of heat units and we can readily translate that into so many square feet of radiation.

MR. W. W. MACON: I notice that according to Mr. Busey's figures that there is a relatively constant efficiency for a considerable range and rate of firing. I do not recall seeing similar tables, but I know that point has been raised, particularly in connection with catalogue ratings, where it is evident that the rating has been a mathematical calculation, that is, a series of ratings has been developed from one particular test. Mr. Busey's curves show that if we do not give ratings for, say, a fuel consumption of less than 4 lbs. of coal per hour per square foot of grate, the error is not large.

MR. BUSEY: I have found that with most boilers the efficiency curve is fairly flat, that is, within 80% to 100% of the boiler's rating, the efficiency is fairly constant. When forcing house-heating boilers 50% to 60% overload, the efficiency begins to drop off rapidly. Then again, I have run them as low as 16% to 18% of their capacity, and the efficiency dropped off to perhaps 20%.

PRESIDENT BOLTON: For several years I have inquired high and low among the large boiler makers for results of tests run below 50% of boilers' rated capacities and have not been able to learn of such records. Inasmuch as a great many boilers, both used for power and for house heating, are operated for a considerable portion of the time very much below their ratings, sometimes even below 50% of their rated capabilities, it becomes important to know what they will do at such low rates of output. Mr. Busey makes the statement that when running boilers as low as 15% of their ratings the efficiency is only about 20%, which is an indication of the inefficiency of many steam heating boilers, because for a large part of the season, in most sections, a comparatively low output is required on the part of the boilers occupied in heating service.

The Importance of Vacuum Cleaning to the Ventilating Engineer

A review of the progress of vacuum cleaning and an estimate of the present and future state of this branch of engineering were brought out at the recent meeting of the heating engineers in a discussion devoted to the topic of the importance of vacuum cleaning to the ventilating engineer. President Bolton stated that it was very interesting to see how the heating profession is reaching out in this direction. Just before leaving New York, Mr. Bolton said he had received the report of an examination of a vacuum cleaning device which comes strictly within the purview of the heating engineer. It is a new device which produces a vacuum by the steam raised, and a gas fire is utilized to dry and burn the dust which is caught by the apparatus. (This device was illustrated in detail in THE HEATING AND VENTILATING MAGAZINE for September, 1911.)

Prof. John R. Allen told of the experiments on vacuum cleaners which had been made in Detroit before purchasing vacuum cleaners for all the schools of that city. Prof. Allen was a member of the commission, and stated that while the report itself was not ready for publication at that time, some things connected with the investigation could be stated. "In the first place," he said, "the vacuum cleaner men do not know yet just what they are doing. Some of the cleaners have given vacua all the way from 7 in. to 15½ in. Vacuum pumps are used in this connection that produce anywhere from 2 to 26 in. of vacuum. The manufacturers seem to have very little knowledge of the vacuum required to do certain work. The weight of the machines required to do the same kind of work varies all the way from 500 to 7000 lbs. So there seems to be no agreement among vacuum cleaning people as to the methods that should be followed in getting results. The methods have not been standardized at all.

"When it comes to cleaning," continued Prof. Allen, "as far as the speed of the cleaning is concerned, the vacuum cleaner can never compete with the broom. We made a test in one schoolroom and allowed all the vacuum cleaner men to clean a room around the seats. The work required from 15 to 26 min. Then we put a janitor in with a broom and he did the same work in between 3½ and 4 min. As far as the work is concerned, it is a little more work for the janitor to sweep with the cleaner than with the broom. Undoubtedly there has been a great advantage in the elimination of dust and the vacuum cleaner recommends itself for introduction in school work for that reason.

PRESIDENT BOLTON: In the department store of R. H. Macy & Co., New York, vacuum cleaners were installed and we were unable to clean the carpets with 8 in. of vacuum. The dust and dirt ground into the carpets on account of the traffic made it necessary to raise the vacuum to 15 in. before the dirt could be raised.

DR. W. F. COLBERT: I might say that vacuum cleaners have proved very satisfactory in modernly constructed hospitals. The present method of schoolroom construction, however, is not adapted to vacuum cleaning. If the hospital method of construction were followed, of having curves instead of corners at the baseboard, and if schoolrooms had washable floors, with the desks set into the floors and the floors rounded up about the desk legs, there would be no room for complaint. But I might say, in that case, there would be no use for vacuum cleaners except for cleaning floor coverings, which would probably be removed from the rooms each day and cleaned in the yard. The walls and floor of a schoolroom properly could be washed down every day.

PROF. ALLEN: I agree with the statement that the question is one regarding the construction of the school. The construction of the modern schoolroom is not to be recommended. A schoolroom should be made so that it could be washed.

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RECENT heavy rainfalls, especially in the vicinity of New York City, have been observed with much interest by heating engineers in view of the recent discussion as to the effect upon the climatic conditions of a great city of the vast quantity of heat emanating from its industries and from the heating of its buildings. It was indicated that this great emission of heat might be capable of producing some effect upon the rainfall, and the records show that New York has experienced a continuous decrease in precipitation during the winter months since 1884. At the same time it was shown that the number of cloudless days has considerably increased. These, it was stated, are indications of a growing dryness which appear to accompany a decrease in the annual precipitation. While this deduction may not in the least be affected by the heavy rains of the last few weeks, especially as they occurred outside of the heating season, nevertheless, it should be noted that the total rainfall for the year 1911 up to the end of September is 27.35 in., as against 25.62 in. for the corresponding period last year. Applying the figures of the remaining months of 1910 to this year's figures to date, the totals would read 41.71 in. for this year as against 39.98 in. for 1910. This will be but 2.92 in. below the normal.

WITH this issue we conclude the publication of Byron T. Gifford's series of articles on the subject of "Central Station Heating." The articles have proved of such wide interest that they will be published in book form, supplemented with a quantity of additional matter that will make the work thoroughly comprehensive. Central station heating has long felt the need of an authoritative treatise covering every phase of the industry, and Mr. Gifford's forthcoming book, therefore, will be the pioneer step to this end.

A COLLECTION of ten formulas, published on another page of this issue, for use in calculating heating requirements, forms a striking illustration of the variety of methods that are used, not only by central station men, from whom the formulas in question were received, but, we dare say, by many other heating engineers. As the formulas stand, however, they are hardly an edifying commentary on the progress made towards standards in heating practice, for their application to a typical problem, it is stated, will give as many solutions as there are formulas. Yet they are interesting because they are the rules that are actually in use to-day by the parties presenting them and are being applied, no doubt, to hundreds of buildings yearly.

Central Station Heating

By Byron T. Gifford

7.—MAINTENANCE

(Previous articles in this series: "Pipe Line Losses from Radiation," April, 1911; "Rates," May, 1911; "'Ready to Serve' or 'Maximum Demand' Rate," June, 1911; "Operation," July, 1911; "Pipe Line Losses from Friction," August, 1911; "Management," September, 1911.)

Maintenance of heating property might be called the care necessary to keep the property in first-class condition. The maintenance of the heating station is very similar to any steam-generating or coal-burning plant. It seems unnecessary to mention the essential points in this connection, but too much can never be said on this point. It is obvious that in any plant the old saying, "a stitch in time saves nine," is very true. Procrastination in this respect is decidedly costly and detrimental to good results.

At the first sign of weakness the weakest part should be replaced or repaired at once. It is often a question whether to repair a weakened part or to replace it with a new one. That can only be decided by experience, but "when in doubt replace it" is a good proverb to remember and to be guided by, especially if the part in question is of any importance in giving uninterrupted service. Every little detail should be carefully watched. If the needed repairs and replacements are allowed to go unheeded the inevitable result will be a breakdown with the cost of repair increased many times.

If a plant is allowed to get dirty it soon develops careless habits among the employees and this, of course, is bad. Keep the floor of the plant swept up and use a little paint now and then. It all helps wonderfully. Cleanliness and neatness will give greater returns per dollar spent than any other little thing that can be done. The manager, superintendent and chief engineer should be cranky on this subject. The details of maintenance of boilers, furnaces, pumps and other machinery are well known and understood and will not be noted here.

The care of the pipe line in a heating system is very important and also comparatively easy. As a general rule it is not a good policy to be looking for trouble, but in pipe-line maintenance it is the opposite—we should be looking for trouble so that the instant anything develops it can be remedied.

Leaks are the worst of all troubles, due to the deteriorating effect they have on the line. A leak of either steam or water causes the pipe to corrode, the covering to deteriorate and the efficiency to decrease. The loss of heat in the leak itself is sufficient to warrant immediate repair, but this loss

coupled with the permanent depreciation of the pipe line makes it all the more important that this deteriorating cause be stopped.

It is not difficult to locate leaks in a pipe-line system. In any system the leak will either show up on the surface of the ground by melting the snow over the line or by causing a wet spot to appear. If the street is paved or for any other reason the dampness cannot get to the surface the condensed steam or hot water will follow the conduit, covering or underdrain to the nearest manhole and can be detected there.

It is at these places that we should be looking for trouble. Oftentimes a leak will make sufficient noise to be heard quite a distance and listening for this noise will often help. It is probably unnecessary to explain how to discover leaks. It requires only a little common sense.

If the piping is made up in place by an experienced pipe-line foreman there is little chance for leaks. Before the pipe line is covered it should be tested or, at least, a test applied before the line is completely covered, so that a leak can be detected easily if there is one. After the line is once tight there is little chance of a leak developing except at the moving parts and these moving parts should be so arranged as to allow frequent and easy inspection. It will be noted that while leaks are very bad, yet the possibility of leaks in the pipe is very remote, but in the moving parts this is different. In these places leaks are apt to develop, and while the effect on the physical condition of the line is not as bad, for the reason that moving parts are usually in a manhole, yet the loss of heat from a leak of this kind makes it imperative that the leak be stopped.

Underdrainage is also important to the life of a pipe-line system if, of course, the line is not laid in a loose soil such as sand or gravel. If it is laid in that kind of soil extreme care should be taken, to be sure that there is no chance for any water to stand around the pipe line, and, if there is the least doubt about it, put in the underdrain. It is necessary to keep the underdrain working and inspection holes should be put in the drains at manholes so that it can be seen that it is operating. Tests should also be made from one manhole to the next to prove that the drain is open. This can be done by pouring water into the drain and seeing it pass the next inspection hole.

If the pipe line is kept dry the efficiency is kept high, but if the line is covered with water the efficiency is reduced many fold and, in addition, the covering is materially effected by being wet or by alternating dry and wet conditions. It is obvious, therefore, that it is essential that the line be perfectly drained.

Traps should be cleaned and inspected regularly. Of course, traps are used only on steam systems. It is necessary to have a by-pass around the traps so that the traps can be taken out and cleaned and not interfere with the operation of the line. If a trap should stop operating it will not cause any serious result, as a rule, but it can cause a water hammer, consequently it is bad policy to allow a trap to stop. They should be inspected at least once a week unless experience has taught that is too often, which the writer thinks will not be so. Traps are usually set in a manhole or in a place that can be entered often and easily.

The traps should be connected with a sewer or some convenient drain for handling the condensation. Cooling coils of some kind should be arranged so as not to cause vapor to rise from the sewer connections to the street.

Meters demand close inspection and, as these instruments are used to measure line condensation, we must consider their care under pipe-line maintenance. It is especially essential to watch the meters to see that they are clean and operating perfectly. Meters should be tested every year and cleaned at least once every year. It is often necessary to clean them oftener, especially on a new installation and, for that reason, a by-pass should be installed around the meters as well as the traps. Between the meter and the trap a telltale pipe should be connected so as to allow inspection to ascertain whether or not the trap is blowing steam.

Always place the meters and traps in as dry a place as possible and place them in such a position that they can be taken out and cleaned without much work. Keep them well painted and free from rust. During the summer months both the meters and the traps should be taken out of the manholes and cleaned, painted and tested. Then when the heating season starts they are in fine shape.

Expansion joints should be watched, but they are such a small care that little need be said about them. Keep the brasses clean and free from foreign matter and keep the packing boxes full and not pulled up too tight. The same can be said of valve stems. Keep them packed well and pulled up just enough to stop any leaks around the stem. It is often advisable to place a shield in the form of a half-circle over the brass sleeve of the expansion joint to protect it from scratches caused by stepping on it in getting in and out of the manhole. These shields do not cost much and are very serviceable.

All cast-iron fittings and all pipes that are not covered and the inside of all manhole covers should be kept well painted with a good quality of iron paint.

Avoid letting any surface water drip through the manhole covers. This can be easily done by casting a trough on the inside of the manhole cover frame to catch this water and pipe

it away to the underdrain or sump in the bottom of the manhole. If the manhole covers are already in place without the trough it can be easily made of heavy galvanized iron and attached to the frame.

As stated before, we should not wait to have troubles show themselves on the surface before attending to them. Dig into the proposition and find out if there is anything wrong.

Pipe-line maintenance is not expensive. It is a very small percentage of the original cost. On a plant with five and one-half ($5\frac{1}{2}$) miles of mains and laterals, one man at $75.00 per month and a helper at $60.00 per month can completely overhaul the entire line in thirty days in the summer and one day a week will suffice for inspection and repairs during the heating season. The cost of material for the repairs and maintenance will average about $220.00 per year for five miles or about $40.00 per mile per year. The labor per year amounts to approximately $315.00 or about $57.00 per mile per year. As the average pipe line costs about $25,000.00 per mile, we can see the maintenance is less than one-half of one per cent. per annum of the first cost, which is a decidedly low maintenance cost and a property can be maintained properly for that amount. There is, then, no excuse to offer for not using all diligence in maintaining the pipe line properly. A property well maintained will depreciate in value to a far less extent than if not kept up.

Depreciation and maintenance are closely allied.

This article brings to a close Mr. Gifford's series of papers on Central Station Heating. We are pleased to announce that this matter, together with a quantity of additional data on district heating practice, written and compiled by Mr. Gifford, and covering every phase of the subject, will shortly be published in book form by the Heating and Ventilating Magazine Company. The work will constitute the first comprehensive handbook to be published on Central Station Heating and will embrace not only its engineering features, but will go extensively into the matter of franchises and kindred subjects.

Relative Economy of Intermittent and Continuous Heating

A chance remark made at the recent summer meeting of the heating engineers led to an extended discussion of a subject that was not down on the programme, but which proved one of the liveliest interest to those present. Speaking to the topic of "The Operation and Care of Heating and Ventilating Apparatus," William M. Mackay made the observation that "it takes more coal to raise the temperature in a building than it does to maintain it."

PROF. ALLEN: In regard to the question of the effect of heating at night or allowing a building to become cold at night, this last winter we had an opportunity to experiment with these conditions at the University of Michigan, where we burn about 100 tons of coal a day. We operate a plant of 3000 H. P. and we experimented as to whether it would be more economical to allow the buildings to go cold on Saturday afternoon and reheat it Monday morning or to keep them heated during the entire period. The results showed that it took about one ton more coal to maintain heat in the buildings over Sunday than to allow them to go cold and then reheat them.

N. L. PATTERSON: In connection with the Chicago public schools we have a bulletin calling the engineer's attention to the fact that he will be required to have the buildings in proper condition as to temperature Monday morning. Where severe weather sets in Saturday or Sunday he must visit his building and keep his heating plant in operation. As a rule, however, with modern plants such as we are now using, very few engineers attempt to run the system over Sunday.

MR. WEINSHANK: To sustain Prof. Allen's statement I will add that in designing plants where intermittent heat is to be used. I always find it good practice to increase the radiation about 30%. I also find that additional amount of fuel thus consumed in a season corresponds to the extra amount of radiation put in.

I can cite a case where a Roman Catholic Church and Presbyterian Church were within two blocks of each other. They were both of about the same size and the janitors of the two churches exchanged notes regarding the fuel consumption. In the Presbyterian Church, which was only heated Wednesdays, Saturdays and Sundays, they burned about 25% or 30% more fuel than in the Roman Catholic Church, where the temperature was kept at 70% all the week and 24 hours a day. In designing work, I usually tell the owner that it will be cheaper for him to keep up steam continuously during the heating season than to let the building cool off at intervals. Several look at the statement skeptically but, after a trial, they find it is cheaper for them to keep up steam and give the apparatus the care that it requires.

Any heating apparatus, operated intermittently, also suffers greatly from wear and tear. Steam fitters will tell you that in such cases they are often called upon to replace cracked radiators and bursted sections or leaky tubes of boilers.

Institute of Operating Engineers

Following are the officers elected at the first annual meeting of the institute, held September 1-3, at the Engineering Societies Building, where the institute's headquarters are located:

President, J. C. Jurgensen; vice-president, for one year, Willis Lawrence; vice-president, for two years, W. B. Ennis; vice-president, for three years, J. G. Ould; secretary, H. E. Collins, and treasurer, W. P. F. Hill.

Legal Decisions

Plans Must Be In Accordance With Accepted Proposition

In an action for the balance of the contract price for building a schoolhouse it appeared that when the contract was signed, ventilators had not been discussed and it was not known to the contract parties that they would be referred to in the plans. The estimate was made from a picture of the schoolhouse. When the plans were presented to him the plaintiff said he would not build, as they had been changed and handed them back. There was evidence that a trustee then stated that they would leave the ventilators out. The plaintiff thereupon began the work and erected the building without ventilators. After its erection the trustees refused to payment of the balance of the price until the ventilators had been put in. It was held that as the plans and specifications when finally prepared were not in accordance with the proposition which the contractor made and the trustees accepted, the former was not required to put in ventilators unless, after the plans were presented to him, he approved of them and agreed to build upon them.—Smith vs. Russell, 129 N. Y. Supp., 461.

Breach of Warranty of Hot-Air Wood Furnace

In an action for damages for breach of warranty that a hot-air wood furnace would properly heat a dwelling house in which it was erected, evidence for the defendants that they had erected other heating plants with the same kind of furnaces, and that they had all been efficient, and some had satisfactorily heated houses of equal size with the plaintiff's with wood fuel was held inadmissible on the ground that the evidence had no tendency to show that the furnace in question complied with the warranty. The plaintiff's claim was that the furnace was better adapted to coal than wood and would not heat the house with wood, which was what it was agreed that he should burn.—Watkins vs. Phelps, Michigan Supreme Court.

Lien on Property for Price of Steam Heating Plant Installed with Owner's Consent

The defendant was owner of premises leased to a tenant for three years. The tenant employed the plaintiff to install a heating apparatus in the premises, and the work was completed about a month before the tenant left the premises, which was a year before the expiration of the lease. He failed to pay anything for the work, and the action was brought to foreclose a mechanic's lien placed upon the premises, and was instituted against the landlord on the theory that she consented to the improvements and became thereby liable for their cost. The New York lien law provides that contractors and others who perform labor or furnish material for the improvement of real propety with the consent of the owner shall have a lien upon the property. It was clearly established by the evidence that the lease provided in express terms that the tenant should have a steam heating plant installed in the premises, for which he was allowed the sum of $200 per month by way of deduction from the rent. It was also undisputed that the landlord called on the plaintiff and sent him to the tenant to make the contract for the work. The plaintiff thereupon saw the tenant, secured the contract, and performed the work; but his demand for payment from the tenant was refused. On appeal it was held that the case as made out by the plaintiff established a cause of action and judgment dismissing the case was reversed and new trial ordered. The provision in the lease in reference to the work and the act of the landlord in directing it constituted a sufficient consent within the purpose and requirements of the statute.

The case is similar to N. Y. Elevator Supply Co. vs. Bremer, 74 App. Div., 400, 77 N. Y. Supp., 500, where it was held that where a lease contained a covenant by which the lesses agreed to install a steam heating and elevator plant upon the premises at their own expense, the plant to belong to the lessors at the completion of the term; and the lessees entered into a contract for the work with the knowledge of the lessors, the inference was justified that the work was done with the consent of the lessors, rendering the property subject to a mechanic's lien for the cost of the work.—Meistrell vs. Baldwin, New York Appellate Division.

Van Auken Patent Not Anticipated

The Van Auken patent, No. 828,153, for valve mechanism for discharging air and water of condensation from steam heating systems, was not anticipated, although the elements of the combination were all in the prior art in some form, and it discloses invention. While not a pioneer in a broad way, the claims are entitled to a reasonably liberal construction. The first four claims, while broad in terms, must be limited by the specification and drawings to a structure in which the conduit between the radiator and the

float chamber opens into the chamber above the line at which the water of condensation therein lifts the float. As thus limited, the patent is not infringed by the device of the Boegen patent, No. 959,297.

The Canfield and Van Auken patent, No. 890,555, for a discharge valve mechanism for steam radiators, is not infringed by the device of the Boegen patent.—Van Auken vs. Monash-Younker Co., Circuit Court, N. D., Illinois, E. D.

Changes in Street Grades

The Supreme Court of Indiana holds that a light and heating company is not entitled to an award for damage caused its property by a change of the grades of streets made by the city in making an improvement under the track elevation statute of March 3, 1905 (Indiana Acts, 1905, c. 82), thus invalidating an assessment of such damages by the board of public works.—City of Indianapolis vs. Indianapolis Light & Heat Co.

No Rights Under Surety Bond Without Priority of Contract

A board of education contracted with an engineering corporation to install a heating and ventilating equipment in a public school building, and the contractor gave the bond of a surety company. The contractor did not perform the work, but another company subsequently did. Under a contract with this company, the plaintiff in an action against the surety company furnished and installed the covering for the steam pipes which formed part of the heating apparatus. There was no contractual relation between the plaintiff and the first corporation or the board of education. It was held that though the plaintiff furnished the material and installed the covering of the pipes it could not recover against the surety on the bond, because it did not appear that the material was furnished or the labor performed under a contract with, or at the instance of, the original contractors, whose conduct was assured by the surety company or with the board of education. —Board of Education vs. United States Fidelity & Guarantee Co., Missouri.

When Is a Ventilating Apparatus "On Sale" Within the Patent Law?

In an equity action to restrain the infringement of letters patent for improvements in a ventilating apparatus the defendant pleaded in substance that during the pendency of his application, the patentee represented to the Commissioner of Patents that the subject matter of his application, shown in his specification and drawings, had been "in public use and on sale and had been sold in the United States of America more than two years before (the) application was filed" in the Patent Office, March 5, 1908; that the patent was therefore void, because of the Commissioner's error in granting it. There was no public use of the invention, and the question before the court was therefore: Was the invention on sale before March 5, 1906? The phrase of the statute, Rev. Stat., § 4886, is "not in public use or on sale for more than two years prior to his application."

The file wrapper showed that the application was originally rejected by the Patent Office because of a prior disclosure of the invention in certain patents which did not lay claim to it. There was disclosure, but no interference. The file wrapper went on to show that the patentee, in order to meet the effect of the admitted disclosure, and to overcome the action of the Patent Office, filed there, under rule 75, two affidavits for the purpose of carrying back his invention beyond the date of the disclosure.

In interpreting Rev. Stat. § 4886 several things are to be noted: First, the patent fails if the invention is on sale by any person, with or without the patentee's knowledge, consent or approval. It was otherwise under the statute of 1836. Second, the invention may be "on sale" though there is no sale. It was otherwise under the statute of 1839. Third, a single unrestricted sale is sufficient. Fourth, the mere manufacture of the invention does not defeat the patent, nor does the physical non-existence of the article save the patent from the operation of the statute. The court held that the apparatus was "on sale" prior to the period of two years.

A manufacturer who at a given date agrees to the course of business to make, sell and deliver at a later date according to drawings then in existence, apparatus afterwards patented, appeared to the court to have that apparatus on sale at the later date, if not at the earlier.

The complaintant contended that the manufacture and sale should be looked upon as merely experimental, and therefore not within the scope of the statute. There was, however, nothing in the record to show that the apparatus was the first constructed by the complainant. The burden of proving that the use was experimental rested upon the patentee.—McCreery Engineering Co. vs. Massachusetts Fan Co., Massachusetts Circuit Court.

Rates for Heating

Central heating companies at present favor the use of a meter that measures the condensation from the various radiators and pipes throughout the building. For this condensation a price usually about one-tenth of the cost per ton of anthracite is made for each 1000 lbs. of condensation measured, on which basis it is assumed

that the maximum efficiency of an ordinary isolated private heating plant would be an evaporation of 5 lbs. of water per pound of fuel, in which case 1 ton of fuel would produce 10,000 lbs. of steam.—*From report of Committee on Data, National District Heating Association.*

The Use of Temperature Records

A correct record of the outside temperature and wind velocity daily should be kept by each manager. It is astonishing how little accurate observation of temperature conditions prevails among heating plant customers. A few warm days in a winter month will be clearly remembered, the cold ones entirely forgotten, with the consequent impression left that the month was comparatively warm. When the bill for the month's heating is received there is usually a complaint, which the temperature records will prove to be without foundation. Very few customers realize the effect of the outside temperature, and especially the wind velocity, upon the consumption of heat, and many of them have an idea that their bills for the three winter months should be practically uniform, when, as you know, there is often a wide variance in the temperature conditions.—*George W. Wright before the National District Heating Association.*

Ventilating the Pennsylvania Railroad's Tunnel in Baltimore

The Pennsylvania Railroad is installing a large ventilating plant in one of the tunnels under Baltimore. This tunnel is 4,963 ft. long and has a cross sectional area of 432 sq. ft. It was determined that it would require 450,000 cu. ft. of air per minute. This volume will drive a current of air through the tunnel with a velocity of 12 miles per hour, and will give a complete air change in 4¾ minutes.

Immediately over one of the portals is the fan room, the floor of which is 28 ft. above the tracks. In this room are two large electrically driven Sirocco fans, with fan wheels or impellers 12½ ft. in diameter. A division plate divides the breadth of these wheels into two equal sections and air is received from both sides. The air is discharged downward into the tunnel through a nozzle which lies close to the roof. This nozzle is flattened and curved to fit the tunnel arch, so that the air comes out through a slit along the arch extending from the springing line at each side. This draws in air from the portal on the principle of an injector. When a train is moving with the air current, the smoke is driven ahead of the engine; when moving against it, the smoke is blown back over the cab without bothering the engineman.

To discharge the volume of air required and to overcome the friction resistance of the tunnel, the fan wheel must revolve at a speed of 104 R. P. M., which will require about 190 H. P. to drive it. Only one of these fans is intended to be run at a time, the other is held in reserve for use in case of accident.

Charles S. Churchill, chief engineer of the Norfolk & Western, who designed the ventilating plants of the Gallitzin, the Big Bend and the Elkhorn tunnels of the Pennsylvania and the Norfolk & Western, also designed this plant.

Current Heating and Ventilating Literature

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

AIR CONDITIONING

A Large Fan and Air Conditioning System for a Cotton Mill. L. L. Lewis. Illustrated description of a large fan for supplying air in a New Bedford, Mass., mill. 1000 w. Eng News—Aug. 24, 1911. 20c.

CAR HEATING AND VENTILATING

Heating Cars Containing Perishable Freight. E. F. McPike. Read before the Peoria Div., Am. Assn. of R. R. Supts. Discusses methods, especially the successful use of the charcoal heater. 2500 w. Ry Age Gaz—Aug. 18, 1911. 20c.

Ventilation of Sleeping Cars. Thomas R. Crowder. Abstract of a paper read before the Am. Pub. Health Assn. Also editorial. An investigation of the quality of the air and discussion of the requirements. 4000 w. Ry Age Gaz—Aug. 25, 1911. 20c.

DUST PREVENTION

The Dust Nuisance, Its Evils and Abatement. John S. Brodie. Paper read before the Royal Sanitary Institute. 700 w. Surveyor—Aug. 18, 1911. 40c.

FEED-WATER HEATING

Bleeding Receiver to Heat Feed Water. Gives calculation showing how a saving of 4.74% of the heat in the steam may be saved, theoretically, by using steam from the receiver to raise the feed-water temperature from 100° to 210° F. 1600 w. Power—Aug. 8, 1911. 20c.

VENTILATION

The Cooling and Ventilation of Engine Rooms. Discusses the problems involved and their solutions. 2000 w. Elec Engr, Lond—Aug. 11, 1911. 40c.

VENTILATION, MINE

Reversing the Ventilation. T. A. Southern and H. W. Halbaum. An extended discussion of the reversal of ventilation which is normally either of the exhaustive or of the compressive type. 4600 w. Col Guard—

July 18, 1911. 5300 w. Aug. 4, 1911. 3800 w. (8 figs.) Aug. 18. Each 40c.

A Large Fan and Air Conditioning System for a Cotton Mill. L. L. Lewis. Describes plant having a 20-ft. fan driven by a 125-H.P. engine. 900 w. (1 fig.) Eng News—Aug. 24, 1911. 20c.

HOT AIR HEATING

Unusual Type of Blower Heating System. Illustrated description of gas engine jacket and exhaust utilized to heat water for fan heaters. 1300 w. Met Work--July 14, 1911. 20c.

HOT-WATER HEATING

Hot-Water Heating by Forced Circulation. Ira N. Evans. Describes this system. Diagram. 3000 w. Power—July 18, 1911.

Troubles with Hot Water Piping and Hot Water Supplies in Buildings. George C. Whipple. From a paper read before the American Water Works Association, Rochester, N. Y., June 8, 1911. 8300 w. Eng News—July 13, 1911. 20c.

THEATRES

The Heating and Ventilating of Theaters. Charles L. Hubbard. Illustrates and describes advanced ideas. 3000 w. Br Build—June, 1911. 40c.

A Remarkable Fan Performance

In a recent test of the Cycloidal fan, patented and manufactured by the Garden City Fan Co., Chicago, some remarkable results were obtained. The test was made by a well-known Western firm of architects of a No. 12 Cycloidal blower installed in the First Church of Christ, Scientist, in Winnipeg, Man. In a letter giving the results of the test, the writer states:

We have tested the No. 12 Cycloidal blower which you installed in this building with the following results:

Velocity of fan, 150 R. P. M.

Area of duct at fan discharge, 12¼ sq. ft.

Velocity of air, 2000 ft. per minute.

Volume of air delivered per minute, 24,500 cu. ft.

Air pressure in duct, ⅜ oz.

Electric current consumed, 3 K. W. per hour, equivalent to 4 H. P.

The blower was driven by a 5 H. P. electric motor, with a countershaft intervening to reduce speed. Some belt slippage was observable during the test.

The air was discharged into a trunk duct leading to furnace, then into a distributing duct system supplying the building. The duct system was only partially installed, the fan under test being required to deliver air through a duct system with a reduced capacity than the fan was designed for, and there was considerable back discharge at the intake, giving evidence that the fan had reserve capacity, which it was unable to develop owing to lack of capacity in the duct system. Notwithstanding this belt slippage and reduced duct capacity, the performance of the blower was substantially up to your guarantee, and quite satisfactory to us, in fact, we consider it quite remarkable. Yours truly,

(Signed) JORDAN & OVER.

The above tests were not factory tests, but, as the letter indicates, were made under operating conditions, and on an installation made hundreds of miles from the factory where they were built.

Delegates to the National Conservation Congress

The following were the representatives of the American Society of Heating and Ventilating Engineers named to attend the Third National Conservation Congress at Kansas City, Mo., September 25-27: J. H. Kinealy, chairman; J. H. Kitchen, B. C. Davis, J. M. Kent and A. H. DeLannay.

The society reports that at a recent meeting of its board of governors, 19 applications for membership were approved.

American Society of Mechanical Engineers

The nominating committee of the American Society of Mechanical Engineers, consisting of R. C. Carpenter, chairman, R. H. Fernald, A. M. Hunt, E. G. Spilsbury and C. J. H. Woodbury, has named the following ticket, to be voted on at the society's forthcoming annual meeting, December 5-8:

President, Alexander C. Humphreys, Hoboken, N. J.; vice-president (for two years), Wm. F. Durand, Stanford, Cal., Ira N. Hollis, Cambridge, Mass., Thos. B. Stearns, Denver, Col.; managers (for three years), Chas. J. Davidson, Milwaukee, Wis., Henry Hess, Philadelphia, Pa., George A. Orrok, New York; treasurer, Wm. H. Wiley, New York.

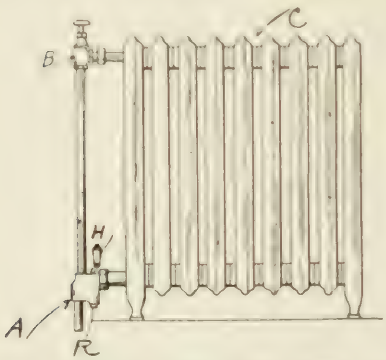
Draper's Self-Recording Thermometer, also Draper's Self-Recording Hygrometer, for measuring the amount of moisture in the atmosphere, are the subjects of two card circulars being sent out to the trade by the Draper Mfg. Co., 152 Front street, New York. The recording thermometer is made in two sizes, with three ranges: 50° below zero to 80° above, 20 below zero to 110° above, 70° to 200° and zero to 260°, depending upon the purpose for which it is intended. The Draper self-recording hygrometer gives a continuous record in ink on a paper chart of the percentage of humidity in the air. The paper chart is actuated by a clock movement and makes one complete revolution in a week. The company also manufactures barometers, rain gauges, wind instruments, anemometers and anemoscopes, both indicating and recording (for measuring direction of wind).

NEW DEVICES

The Wizard Valve Fitting

A new valve fitting, shown herewith, is designed to be used on any one-pipe system of steam heating and, when attached to any radiator in such a system, to convert it into a vacuum-vapor, graduated steam supply apparatus. It is claimed that by use of this device in a one-pipe steam heating system, one-quarter, one-half or all of the radiator surface can be heated, permitting individual control of the radiator to suit the wishes of the occupant or the variations of the weather. It is also found that smaller piping can be used, both in the mains and risers, a ¾-in. graduated or radiator valve being large enough to supply steam to 150 sq. ft. of radiating surface. It is also stated that pipe coils can be operated with this device on a one-pipe system and the steam supply graduated to obtain the desired results. The fitting may be used either with or without air valves. An air valve may be connected at H. The riser connecting with the Wizard fitting is shown at A. B is a graduated supply valve to the radiator C.

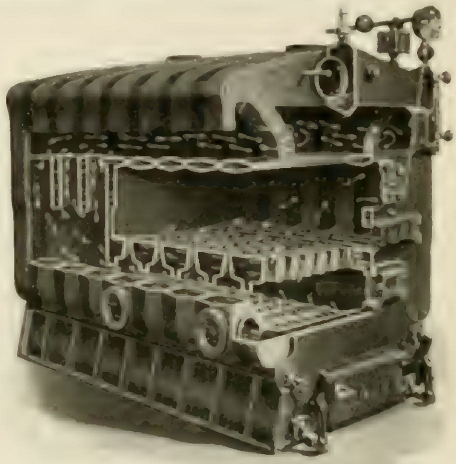
The internal construction of the fitting provides a direct passage through the



RADIATOR EQUIPPED WITH NEW TYPE OF VALVE FITTING

valve fitting from the riser to the graduated valve at the top. A trap in the fitting prevents the steam from short-circuiting into the radiator at the bottom. A ball valve with a suitable seat is provided to form a trap before the trap has filled with condensation. The plug R at the bottom elevates the ball valve to a sufficient height to maintain a water seal or trap in the valve fitting at all times. This valve is the invention of J. J. Wilson, of Philadelphia, a well-known consulting engineer and a charter member of The American Society of Heating and Ventilating Engineers. He has been allowed a patent on the fitting.

Ideal Heating Journal for September, 1911, the new publication of the American Radiator Co., Chicago, is full of hints for the steam fitter as well as for the heating engineer. The *Journal* contains an illustrated description of one of the company's latest products, the Ideal



IDEAL DOWN DRAFT BOILER FOR USE WITH SOFT COAL

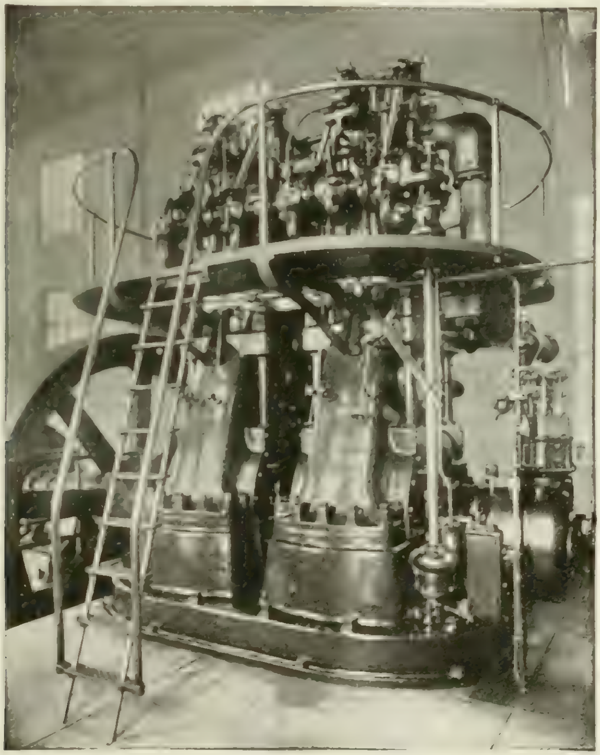
down-draft boiler, which is made exclusively for soft coal. This boiler has been brought out to meet the municipal ordinances of some cities which enforce a certain limit to the time after feeding boilers used in large buildings during which the chimneys may emit smoke. These ordinances usually except residences, but for apartment and other large buildings in charge of a janitor, where the feeding of soft coal is very frequent, this requirement calls for a heating boiler which will burn soft coal and without smoke emission from the chimney. Among the illustrations in the September issue is a typical installation of American Rococo wall radiators in a Turkish bath at San Francisco, the German Emperor's palace at Potsdam, heated with American radiators, the Rayal Automobile Club, London, heated with American direct and indirect radiators and the Bankers Trust Company building, New York, also heated with American radiators and Vento heaters. An article on Rococo wall radiation vs. pipe coils contains some interesting points on the advantages of wall radiation.

Handy Valve Wheel for radiator valves, gauge cocks, air valves, gas logs, etc., is a unique improvement in valve construction patented and manufactured by J. O'Meara, Inc., 103 Walker street,

New York. The handle may be supplied in any selected wood to match the trim of the room. It has no top or bottom plates, nuts or screws and has a door knob finish that prevents burning the hand in opening or closing the valve.

Trade Literature

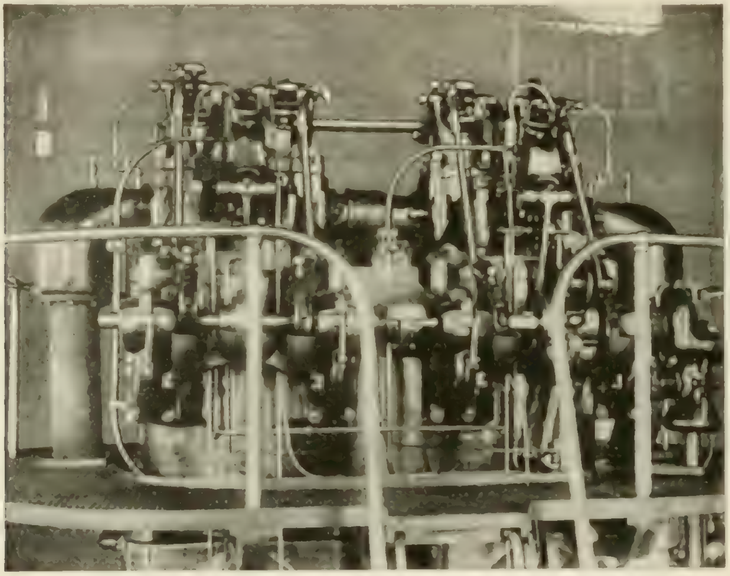
Atlas Crude-Oil Engines (Diesel Type), built in two, three and four cylinder vertical units, respectively, 300, 450 and 600 B. H. P., is a catalogue of unusual interest, published by the Atlas Engine Works, Indianapolis, Ind. Special emphasis is laid on the economy of this type of engine which, it is stated, is capable of producing 1 B. H. P. hour on less than ½ lb. of fuel oil, making $1.35 per 10-hour day for 100 B. H. P., or $2.00 per day for 100 K. W. Comparisons are given showing the relative fuel costs for a steam engine versus an Atlas oil engine with a percentage of saving in favor of the oil engine approximating 80% for each size of unit. Under other headings are treated the comparative costs of power producer gas versus Atlas oil engine, individual plants versus central station service, endurance and economy tests (with tables and chart), mechanical efficiency and economy on light loads, to which is added a detailed description of the design and construction of the Atlas oil engine, illustrated with many photographs Special attention is called to the fact that the Atlas oil engine is not an explosive engine, the air being first drawn into the cylinder, then heated by compression, after whch a fine spray of oil is gradually and steadily injected into the cylinder, while the compressed air is expanding at constant pressure. Combustion, therefore, is gradual, the pressure and temperature in the cylinder never rising appreciably above that due to the compression of air to about 500 lbs. on the first upward stroke. The impulse, therefore, is taken on and relieved gradually so that the engine operates without shock. The temperature necessary for ignition is obtained solely by compression of atmospheric air alone. Pp. 36. Sixe 8x10½ in.



NEW TYPE OF ATLAS CRUDE-OIL ENGINE

Advantages Derived by Positively Freeing Drying Apparatus of Water of Condensation are explained by Mr. C. Hill-Smith, industrial engineer, in a pamphlet published by Warren Webster & Co., Camden, N. J. This deals with the vacuum system as applied to dryers, with special reference to the drying of paper. As compared with the usual method of discharging condensation by gravity, the vacuum system operates with greater difference in pressure between the dryers and the return header, promoting a rapid and positive flow, increasing the efficiency by keeping the dryers free from water. The vacuum valve allows the water and air to be removed from the dryers, but holds back the steam, thus conserving valuable heat and enabling the paper to be dried with less steam or the machine run at higher speeds. In addition to producing difference in pressure, the vacuum pump provides a means of getting the condensation into a tank or heater located within the return header.

United States Boilers, Capitol Sectional Improved Type, is the title of a new catalogue from the United States Radiator Corporation, Detroit, Mich., calling attention in detail to the construction features of this type of heater, which include countersunk headers, long flue travel, extensive heating surface, thin waterways, slip nipple connections, divided sections, large flues, deep firepot, double shakers and convenient shaking apparatus. These points are taken up in order with views of the various parts. Special emphasis is laid on the adherence to the divided section idea on the ground of greater durability through allowing for expansion and contraction. The divided sections also serve to prevent complete disablement as it is a matter of one-half hour's time to unfasten the bolts of a broken section and plug the nipple openings. The catalogue includes figures for roughing-in measurements and has price lists for three complete series of both steam and hot water boilers. Pp. 32. Size 3½x6 in. (standard).



VIEW ABOVE GALLERY, ATLAS CRUDE OIL ENGINE

Triton Packless Water Valve

Interesting features of the Triton packless water valve, which is manufactured by the United States Radiator Corporation, Detroit, Mich., include the following:

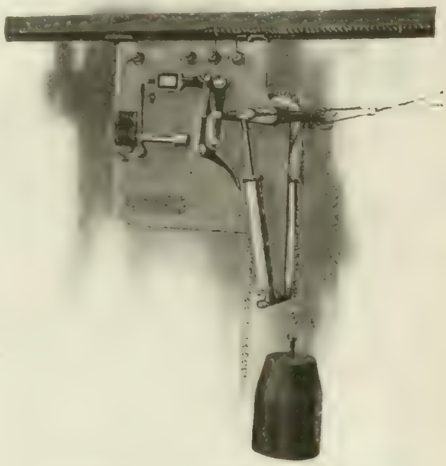
Handle of well-seasoned wood, with a dead black, durable finish. Indicator plate on top to show whether valve is open or shut. Handle holder made substantially of steam metal, and extending down within the inner casing of the bonnet as far as upper washer. Bonnet of one piece with body, extending up under the handle holder, thus protecting the entire working apparatus from external injury. Spring specially tempered and rustless, holding both of the composition washers under firm tension above and below the flange in the bonnet. Stem cast

in one piece with the movable shell, simplifying and strengthening the internal construction of valve, and preventing the detachment of the shell.

Packless Washers, twin washers, giving double protection. Made of a special non-deteriorating composition, and held tightly by the spring, preventing leakage at the stem even under heavy pressure. Movable shell heavily cast, with full size opening. Moves on two points of contact, top and bottom, preventing corrosion and sticking. Opens with half turn. Body made entirely of new metal. Tail piece machined for ball joint, with full-length threads. Union nut with a heavy rim to withstand excessive strain.

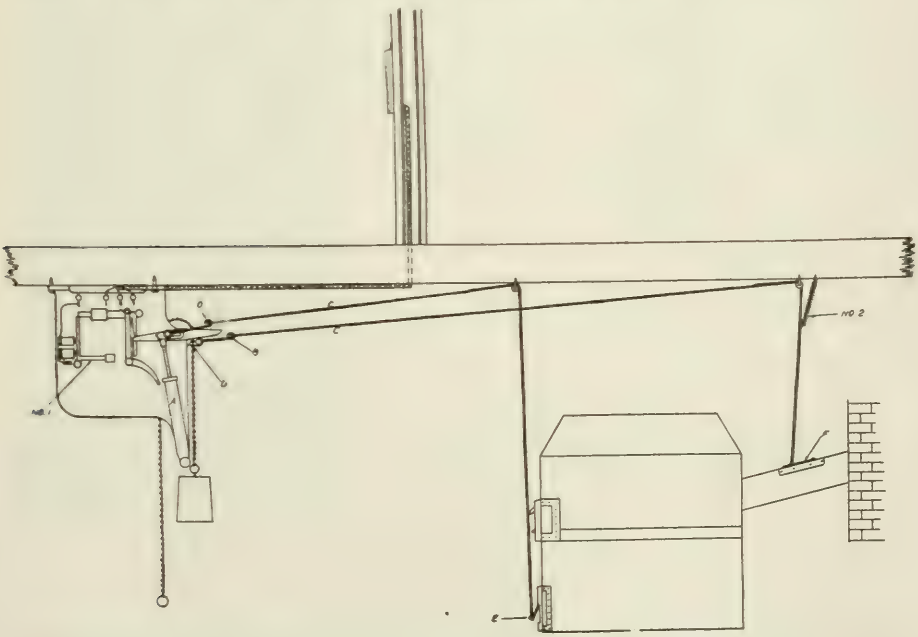
The valve is made in six sizes, from ½ in. to 2 in. and has rough body, plated all over.

Automatic Comfort is the title of a newly-issued circular describing the Crandon Automatic Damper Regulator, made by the Crandon Mfg. Co., Bellows Falls, Vt. The device is styled "the janitor that never sleeps." The device is adapted for regulating the dampers of a hot air, hot water or steam heater and is controlled by a thermostat operated by a weight. The thermostat, placed in one of the rooms of a house, is set at the point at which the desired temperature is to be maintained and operates to open or close the dampers as the temperature falls or rises above this point. The motor, which is fastened with screws to the ceiling of the cellar, is connected by an electric wire with the thermostat in the rooms above. The revolving crank arms of the motor are connected by chains and wires over two pulleys, screwed to



CRANDALL AUTOMATIC DAMPER REGULATOR

the cellar ceiling, with both the draft door and the check draft. To keep the mechanism in operation, the user pulls up the chain bearing the weight once a day. The device is made of aluminum, bronze and brass. Size of circular, 3½ x 6¼ in. pp. 16.



TYPICAL INSTALLATION OF THE CRANDALL AUTOMATIC DAMPER REGULATOR

The SPARKS SYSTEM

THE Successful Contractor is always alert to the interests of his trade. The Architect and Owner are continually looking for appliances that will improve their heating plants and effect a saving in labor and fuel.

The Automatic Vacuum Pump

We have it. *The Sparks System costs nothing* to maintain. Operates *below atmosphere.* Reduces fuel consumption.

With the Sparks System you are enabled to circulate steam throughout the entire heating system, including the boiler, at a pressure less than that of the atmosphere and thereby effect a saving of from 15% to 25%.

It is a recognized fact by the engineering profession of the 20th Century that all heating plants should be equipped with a vacuum system that will actually *produce results without increasing the cost of maintenance* and operation. This demand has become so great that we have in the past year tripled our business.

Why? Because we have the *only apparatus* in use today that will effect a saving and *produce results without the aid of outside power.*

The Sparks System can be applied to existing heating plants as easily as to new ones, regardless of size or character.

Our proposition to steamfitters is most attractive. *No royalties. Absolute protection guaranteed.*

Write for Our New Catalogue

IROQUOIS ENGINEERING CO.

Distributors

Chicago Minneapolis St. Louis Columbus, O.
Kansas City New Orleans Dallas

AUTOMATIC VACUUM PUMP CO.,

Manufacturers and Patentees
Chicago and St. Louis

Watson-Stillman Twinvolute Turbine Pumps are the subject of a noteworthy catalogue, issued by the Watson-Stillman Co., New York. The catalogue is especially useful through the presentation of characteristic curves of different-sized pumps operating under varying conditions. The catalogue is handsomely prepared, with many details and other illustrations from photographs and contains, in addition, much miscellaneous matter connected with the subject of turbines. Size 6 x 9 in. (standard). Pp. 56.

Advertisers' Index

* Every other month

WHAT OUR READERS THINK OF US

Allen-Scales Engineering Co.

D. G. C. VALVE CO

GENERAL ENGINEERING

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1123 Broadway,

New York City.

Gentlemen:

Enclosed find check for $ 1.00, with which renew the subscription of W. H. Allen, changing the subscription to this company.

We want to congratulate you on the magazine which you are getting out, and the class of articles which have been appearing in it. We would not be without the magazine for three time the amount of the subscription.

Wishing you a most prosperous New Year, we remain,

Very truly yours,

WHA-H

ALLEN-SCALES ENGINEERING CO.

W. Harwell Allen

TRADE AND MISCELLANEOUS NOTES

Coming Event

December 5-8, 1911.—Annual meeting of the American Society of Mechanical Engineers, New York. Headquarters at the Engineering Societies Building.

Miscellaneous Notes

Midland Furnace Club held its regular quarterly meeting at the La Salle Hotel, Chicago, September 26.

Anderson, Ind.—Because the franchise of the Home Heating Company's steam heating plant requires that steam heat service for the central section of the city begin on Oceober 1 the Anderson Trust Company, which recently acquired the plant at the receiver's sale, has given notice that it will put the plant into operation. C. W. Hooven, who controls the Anderson Gas Company, has made an offer of $6,000 for the steam heating plant, but the trust company demands $10,000 for the property.

Kalamazoo, Mich.—W. H. Schott, of Chicago, has presented to the city council of Kalamazoo a proposed ordinance for the establishment of a central heating plant, together with a proposed franchise in his favor to lay a system of steam pipes through the streets for heating or other purposes. The proposed franchise stipulates that the plant shall be in operation by October 15, 1912. The city is to be compensated for the use of its streets after 1917 by payment of 1% of the gross earnings until 1920, when 2% of the gross earnings shall be paid until 1925. From 1925 on during the life of the franchise the city is to receive 3% of the company's gross earnings. The franchise is to run for 30 years and the rate of service on the meter basis is 75 cents per 1,000 lbs. of steam for the first 10,000 lbs. per month, decreasing at a rate of 5 cents per 1,000 lbs. for each 10,000 lbs. per month consumed.

Lebanon, Ind.—The Lebanon Heating Co. will be sold at a receiver's sale for the benefit of stockholders and creditors. The plant was built at a cost of $103,000, and supplies heat to over 200 homes in Lebanon.

New Bedford, Mass.—As a result of a misunderstanding of the specifications for the heating and ventilating flues for the new high school building at that place, it is probable that the city council will find it necessary to make an additional appropriation for the construction of the flues. The question at issue is whether the flues were to be of plaster or steel, because if built of plaster, the work would come under the general building contract. The designing engineer has testified that in his specifications he intended that plaster flues should be used while Howard & Sons, the general contractors, declare that the specifications do not contain any clause instructing them to build flues of any sort in the building.

American Institute of Chemical Engineers will hold its fourth annual meeting in Washington, D. C., December 20-22, 1911. Among the papers to be presented will be one on the general subject of patents.

Robert E. Hall has resigned his position as assistant manager of Francis Bros. & Jelett, Philadelphia, Pa., to become vice-president and treasurer of the Goulds Mfg. Co., of New England, Boston, Mass.

W. H. Smead, formerly engineer of the heating and power piping department of the General Fire Extinguisher Co., Cleve-

land, O., has been appointed superintendent of the heating and equipment department of The Samuel Austin & Son Co., Cleveland, O., building contractors.

Engineering News, one of the oldest journals in the country devoted to civil, mechanical, mining and electrical engineering, founded by George H. Frost, and published weekly by The Engineering News Publishing Co., 220 Broadway, New York, has been sold to the Hill Publishing Co., of New York, publishers of the *American Machinist*, *Power* and *The Engineering and Mining Journal*. The purchase price is said to be in the neighborhood of $1,000,000. The editorial policy and management of *Engineering News* will remain the same as heretofore.

Building operations for August from 99 cities show a total of $70,083,293, which is an increase of 24.2% over the corresponding period of 1910. These figures, however, are not as favorable as they appear on account of the fact that the large total credited to Chicago, amounting to $20,200,500, is due to the filling of a number of permits to take advantage of the regulation regarding the heights of new structures, since abrogated by a new law. If the Chicago totals are excluded it is found that the construction permitted for in August aggregated $[illegible], a decrease of [illegible] from July and [illegible] from August a year ago. The figures for Chicago were 288.7% above the same period last year. The figures for some of the principal other cities were: New York, $8,606,800, decrease [illegible]; Pittsburg, $[illegible], decrease 16%; Portland, Ore., decrease 32 [illegible]; San Francisco, $2,139,005, increase 45.3%; St. Louis, $1,631,570, decrease 29.5%; Cincinnati, $1,302,985, increase 120.6%; Cleveland, $1,486,618, decrease 1.3%; Detroit, $1,668,875, decrease 33.1%; Milwaukee, $1,036,196, increase 8.2%; Minneapolis, $1,042,800, decrease 24%.

New York Chapter of the American Society of Heating and Ventilating Engineers may be formed as the result of a meeting held October 10 at the society's headquarters.

Trade Literature

Facts About the Isolated Plant, No. 2, has just been issued by the National Isolated Power Plant Association, New York. It is a 16-page folder calling attention to the work of the association which covers investigations of the relative economy of the isolated plant and central station service both generally and in particular instances. The association has a committee whose special duty it is to investigate and make an unbiased report upon all cases brought to its attention. Thus if an owner is about to construct a new building and is not sufficiently versed in engineering matters to decide whether an isolated plant or central station service is more economical, a member of the association's committee is sent to call upon him and give him the benefit of his expert service. The movement is designed to offset the activities of the central station advocates who, it is claimed, do not always give owners a fair idea of the efficiency to be obtained of the isolated plant when properly operated, with the result that there has been an alarming increase in the num-

ber of buildings using central station service.

A special supplement accompanies the folder stating that after going to press it has been learned that following a long legal battle, the Longacre Electric Light & Power Co. has been granted a franchise to operate in New York City, and has received permission to issue bonds to the amount of $50,000,000. This franchise carries with it the privilege of using the present street conduits for its cables. The company intends to build one or more power houses within the city, but realizing that there are many isolated plants operating considerably under their rated capacities, the Longacre Company, it is stated, has offered to purchase this excess current from the smaller plants at 1½c. per K. W. hour during the daytime and at 1¼c. during the night. This will permit the smaller plants to be run at 100% load all the time. Heretofore, the New York Edison Company has had a monopoly of central station service in New York.

Reilly Multicoil Evaporators, made by the [illegible], New York, intended for producing pure water by distillation from sea water or impure natural water, are described and illustrated in a new catalogue, showing their use for ocean steamships, power [illegible] hotels, office buildings, hospitals and chemical laboratories. The exclusive features of construction of the Reilly multicoil evaporators are used of heating surface composed of coils of seamless copper tube wound to a small radius and secured to headers by ground union joints, and the provision of a large door opening into the shell, through which the coils can be reached when desired. Multiple effect evaporation is secured by combinations of the evaporators and counter current coolers in series. Pp. [illegible] Size 6x9 in. (standard).

Disc and Propeller Fans, Steel Plate Exhausters and Volume Blowers and Exhausters are the titles of three new bulletins issued by the National Blower Works, Milwaukee, Wis., which will be found useful to heating engineers. The various types of each fan are reproduced from photographs, with compactly arranged price lists and dimensions. In the case of the steel-plate exhausters for planing mill service the price lists and dimensions are supplemented with photographic views of the various parts, together with capacity tables for each size from 30-in. to 90-in. fans operating under pressures ranging from 2 oz. to 7½ oz. Pp., respectively, 4, 16 and 8. Size of each bulletin, 6x9 in. (standard).

Graphite for September, published by [illegible] Jersey

City, N. J., features the company's Philadelphia district with a double-page group of photographs of the Philadelphia sales force. Among its contents is an interesting article on the "National One-Cent Letter Postage Association." Hundreds of business men, it states, have joined the association, which has its headquarters in Cleveland. Charles William Burrows is the president and George T. McIntosh, secretary-treasurer. During the month of May, 1911, an investigation in the way of sorting, counting and weighing all the mails was made by the Post-Office Department and these records will be tabulated and the results placed before the postal commission. After this commission reports, legislation will be introduced in Congress bearing upon the various features of the postal question, including the movement for one-cent letter postage. Every concern in the United States is eligible to membership. The headquarters of the association are at 506 Chamber of Commerce, Cleveland, O.

Modulation System of Steam Heating in the Sumner Apartments, Newton Centre, Mass., is another publication in the interesting series being published by Warren Webster & Co., Camden, N. J., devoted to illustrated descriptions of typical heating layouts. Basement and typical floor plans are shown, also an isometric view of a typical piping arrangement. Pp. 8. Size 6 x 9 in. (standard).

Steam Turbine Centrifugal Pumps and Other Centrifugal Machinery is the title of a 32-page booklet issued by the DeLaval Steam Turbine Co., of Trenton, N. J., illustrating and describing briefly the several lines of machinery manufactured by that concern, including single stage turbines for driving machinery of all kinds and for rope and belt transmission; turbine-driven centrifugal pumps for water works, for general water service in industrial plants and for boiler feeding, hydraulic pressure work, etc.; velocity staged turbines without gears for direct connection to high-pressure blowers, centrifugal pumps, etc.; multi-stage impulse turbines with gears for driving large direct-current generators, fans, centrifugal pumps and other moderate or low-speed machinery; multi-stage impulse turbines without gears in large sizes for direct connection to high-speed alternators; motor and belt-driven centrifugal pumps for all services and heads; multi-stage centrifugal air compressors and DeLaval speed reduction gears for various services. Copies of this booklet will be sent upon request to those interested.

Scientific Lubrication of Machinery is the title of an attractive 48-page booklet issued by the Richardson Phenix Co. This book gives a detailed description of

Richardson Phenix individual oiling and filtering systems and their many types of oil filters, mechanical lubricators, oil and water separators, sight feed and gang oilers, union-cinch pipe fittings and sight flow indicators, etc. It also contains an interesting discussion on the need and economy of good lubrication and has several pages devoted to the nature and choice of oils, giving simple means by which they may be tested. The information regarding the qualifications of various kinds of oils for different kinds of service should be of value to engineers. This book is one of the most complete treatises that has come to our notice on power plant lubrication and is well worth reading, as it shows how highly this branch of engineering has been perfected for modern power plants.

Monthly Peat Reports, Vol. 1, No. 1, September, 1911, is described as a souvenir and presentation number to commemorate the organization of the Peat Association of Canada. This journal is to be published monthly by the Peat Association of Canada and distributed free for the benefit of all who are interested in the development of Canada's peat resources. The initial issue reviews some of the well-known processes for manufacturing peat and contains news items of the industry in Canada and the United States, as well as in other countries. The Monthly Peat Reports is published from Drawer 2263, Main Post Office, Montreal, Canada.

The Engineering Equipment of Buildings is a handsomely gotten up catalogue just issued by Francis Bros. & Jellett, Inc., Philadelphia and New York, engineers for the design and erection of complete steam power, mechanical, electrical, hydraulic and sanitary equipments of buildings. The publication is quite out of the ordinary, especially as coming from a firm of consulting and contracting engineers. It is issued for the benefit of architects and owners and includes well-executed views of representative buildings in which Francis Bros. & Jellett have either designed or constructed, and in some cases have both designed and erected all or part of the power equipment, mechanical, electrical and fire protection systems. In the 22 years since this company was organized, it states that it has designed or erected work exceeding in cost $14,000,000. Special attention is called to the firm's practice of doing work on the percentage basis which has proved eminently fair to all parties. The catalogue includes a notable array of references and the views of buildings which the company has recently equipped include the Everett Building, New York; Spring Garden Building, Philadelphia; New Dormitory

Building, Hill School, Pottstown, Pa.; Packard Motor Car Building, New York; Brewster & Co.'s plant, Long Island City; Yale & Towne Mfg. Co.'s plant, Stamford, Conn.; C. C. Knight Co.'s Building, Pittsburg; and a group of Philadelphia buildings all in the same neighborhool, including the Pennsylvania Building, Morris Building, New Girard Trust Co. Building, and the West End Trust Co. Building. Pp. 12. Size [illegible] in.

Manufacturers' Notes

Pullman Consolidated Ventilator Co., York, Pa., has been organized, being a merger of the Pullman Automatic Ventilator Co., York, Pa., the Consolidated Ventilating Co., of Rochester, N. Y., and the National Ventilating Co., of New York, all manufacturers of automatic ventilators. The new company is capitalized at $800,000, of which $250,000 is 7% preferred stock. The following officers were elected: President, Freeman C. Allen, Rochester, N. Y.; vice-president, M. D. Kleinzahler, Youngstown, O.; secretary, C. C. Frick, York, Pa.; treasurer and general manager, E. G. Andrews, Rochester, N. Y. These with the following constitute the board of directors: Henry S. Rich, Marietta Burlew Hill, Rochester, N. Y., P. E. Tucker, Rochester, N. Y., and R. Brace, Trenton, N. J. The machinery of the various plants will be brought to York, where all the manufacturing will be done. The company will employ 100 persons. The company will have an initial working capital of $35,000. With the exception of the Pullman, all of the merged companies are owned outright by the new company, the Consolidated Company being represented in the organization at a valuation of $100,000 and the National Ventilating Company at $25,000. The Kleinzahler syndicate, which secured control of the Pullman Company, secured $133,000 common and $220,000 of the preferred stock of the company and paid off $60,000 in indebtedness. This they turned into the Consolidated Company, receiving in exchange [illegible] in preferred stock.

United States Radiator Corporation, Detroit, Mich., has opened an office in Cincinnati, O., in charge of Harold Q. Porter. The company has appointed C. [illegible] as manager of its Pittsburg branch in place of F. M. Mechling, who has resigned.

Isaac A. Sheppard & Co., Philadelphia, manufacturers of furnaces and stoves, has sold its plant in Philadelphia to the John B. Stetson Co., hat manufacturers. The change will become effective July 1, 1912. Isaac A. Sheppard & Co. have another plant in Baltimore. It has not been announced what quarters the Philadelphia plant will occupy.

American Radiator Co., Chicago, is pushing work on its new warehouse at Bayonne, N. J. The company is arranging to keep a stock on hand of 2,500,000 sq. ft. of radiation and several thousand boilers.

Continental Radiator & Foundry Co., St. Louis, Mo., has completed plans to build a new radiator plant with a capacity of 3,000,000 sq. ft. of radiation a year.

Williams Tool Co., Erie, Pa., will build a fireproof factory building 65 x 125 ft., adjoining the company's present plant and doubling its output. The new building will be ready bv January 1, 1912.

American Radiator Co., Chicago, reports the manufacture of the largest radiator ever turned out at its Decatur, Ill., plant. The radiator was made for a job in Wilmette, Ill., and consists of 89 loops. It is 19½ ft. high and weighs about one ton.

Triumph Valve Co., Mansfield, O., is the new name of the Safety Cylinder Valve Co., manufacturers of the Automatic safety cylinder valves, Triumph packless radiator valves and other specialties. The company announces that this is a change in name only, the officers and company remaining the same as heretofore. The officers are: President, Frank Schreidt; vice-president and treasurer, D. J. Balliett; secretary and general manager, Charles E. Schreidt.

Pierce, Butler & Pierce Mfg. Co., Syracuse, N. Y., were among the prominent exhibitors at the recent New York State Fair, held in Syracuse. Other exhibitors of heating goods were the Albany Foundry Co., furnaces and ranges; Sill Stove Works, Rochester; Kelsey Heating Co., Syracuse; Fuller & Warren Co., Troy; the Syracuse Heater Co., and the Syracuse Stove Works.

Beler Water Heater Co., Pittsburg, Pa., manufacturer of automatic instantaneous water heaters, has been reorganized by the election of new officers and directors as follows: President, James Hay; vice-president, John Ellis; secretary and treasurer, W. J. Langenheim; directors: Adolph Beler and Edward Schreiner. The new president, James Hay, was until recently president of the Ruud Mfg. Co., Pittsburg, while Mr. Ellis, the vice-president, was superintendent of the Ruud Mfg. Co.'s factory for several years. W. J. Langenheim was formerly secretary and treasurer of the Ruud Co. The capital stock of the new company will be increased to $250,000. The company will eventually occupy the large factory building at 29th and Smallman streets, Pittsburg, owned by Mr. Hay.

New Firms and Business Changes

H. G. Smith Co., Inc., 150 Nassau street, New York, is a new firm of consulting, heating and ventilating engineers composed of Alfred A. Driggs, formerly of the New York branch of the Pierce, Butler & Pierce Mfg. Co., and Howard G. Smith.

New Incorporations

Jepson Bros. Co., Cleveland, O., capital $45,000, to conduct heating, plumbing and gas-fitting business. Incorporators: James E. Sayne, Peter G. Jepson, Anna D. Jepson, Richard J. Jepson and Minnie A. Jepson.

Mailhus & Co., New Orleans, La., capital $10,000. President, Joseph L. Gautreaux; vice-president, Joseph Mailhus.

Larsen & Wood Co., Toledo, O., capital $10,000, to conduct a heating and plumbing business. Incorporators: Neils S. Larsen, James A. Wood, William J. Fritsche, Mark Winchester and William L. Billingslea.

Frush Plumbing Co., Waterloo, Ia., capital [illegible], to conduct a heating and plumbing business. Incorporators: George H. Frush, Jr., William J. Cosgrove, G. D. Bertram and Stephen Mullany.

Northwestern Heating and Plumbing Co., Evanston, Ill., capital $5,000. In-

corporators: Charles S. Wallace, George A. Kearney and E. Major.

Manufacturers' Sales Co., Columbus, O., capital $15,000, to act as sales agents for heating and plumbing and railroad supplies. Incorporators: Harry B. Mingis, B. J. Corbett, W. R. Jones, Harvard [illegible] and Val Lower.

Schellhammer & Co., Warren, Pa., incorporated to take over the plumbing and steam heating business of Schellhammer & Co. The company is planning an extension of its business.

William P. Morgan Co., Ridgewood, N. J., capital $25,000, to conduct a heating and plumbing contracting business. Incorporators: William P. Morgan and A. Morgan, Ridgewood; and James W. [illegible], Paterson.

Kelley Hardware Co., Farmington, Ia., capital $20,000, to take over business conducted [illegible] and established in 1905. A heating and plumbing contracting department will be added. Incorporators: O. E. Ostru and R. P. Beer.

Excelovalve Co., 25 West 42nd street, New York, capital $500,000, to manufacture flushing valves and water-saving devices. President, E. D. Barrett; vice-president, W. D. Cushman; treasurer, C. I. Wood; secretary, S. Hartman; assistant secretary, J. Stenfield.

American Smokeless Furnace Co., Portland, Me., capital $500,000. President, Clarence E. Eaton; treasurer, T. L. Croteau; secretary, James E. Mantell, Portland.

Daniel E. Walsh Co., Boston, to deal in heating apparatus. Incorporators: Daniel E. Walsh, William A. Walsh and George L. Ellsworth.

New Process Heating & Lighting Co., Laporte, Ind., capital $50,000, to manufacture a new heating and lighting invention.

Edward S. Bradley Co., Manchester, Mass., capital $20,000, to conduct a heating and plumbing business. Incorporators: E. S. Bradley, A. J. Hollings and William H. Allen.

Mosley Plumbing and Heating Co., Wilmington, Del., capital $25,000, to conduct a contracting business in heating and plumbing.

Self-Lighting Orchard Heating Co., Denver, Colo., capital $250,000. Incorporators: Oliver M. Farrand, Henry D. Demont and S. G. McMullin.

Contracts Awarded

Schultz & Seibel, Hannibal, O., steam heating Star Theatre in that city.

Moline Heating and Construction Co., Moline, Ill., heating and plumbing new Ridgeway School building at Moline. The heating contract amounts to $7,631 and the plumbing to $4,787.74.

Arthur B. Mueller Co., Kansas City, Mo., heating Norman Ward School for $5,179. Edmunds & Lovett got the plumbing contract at $1,850.

Neville Kellner & Co., Louisville, Ky., heating Parkland School for $1,852.

Capital Building and Construction Co., Springfield, Ill., heating poor farm at Buffalo, Ill., for $4,711.42.

R. Haas Co., Springfield, Ill., heating poor farm at Buffalo, Ill., for $1,935. The boilers will be located in a separate building which will be built by the Capital Building & Construction Co., of Springfield, at its bid of $4,711.42.

Schulteis Bros., San Diego, Cal., heating and plumbing new county jail at that place for $10,500.

F. F. MacNichol & Co., Oshkosh, Wis., heating and ventilating Shawano County Insane Asylum building for $13,000; also heating and ventilating Outagamie County Court House and the Waupaca high school.

J. J. Hurley & Co., Boston, boiler installation for the Hyde School at their bid of [illegible]

Kohlert & Harter, Aurora, Ill., steam heating [illegible] opera house, for $2,000. 4,400 sq. ft. of radiation will be installed.

Buffalo Forge Co., Buffalo, N. Y., heating and ventilating system in the new carpenter shop of the Westinghouse Air Brake Co., at Wilmerding, Pa. The building will be of brick construction and 210 ft. long.

John W. Danforth Co., Buffalo, N. Y., mechanical equipment of the Mare Island Navy Yard, San Francisco, Cal., at its bid of about $105,000. The power house will be one of the largest maintained by the department. The work is to be finished within nine months.

Kenison Bros., Dallas, Tex., steam heating the court house building at Denton, Tex., for [illegible]

Fitzpatrick & Hoepfner, Columbus, O., heating and ventilating new high school building at Canton, O.

C. W. Nelson, Neenah, Wis., central heating plant in the [illegible] Building. The plant will supply heat to four stores, an office building, the post office and office in the post office building.

Downey Heating Co., Milwaukee, Wis., [illegible]

F. F. MacNichol & Co., Oshkosh, Wis., heating [illegible] Manual Training School, for $7,449: the plumbing contract went to the Toner [illegible] $4,774.

Downey Heating Co., Milwaukee, Wis., heating [illegible] High School in Milwaukee for $5,547; also heating the addition to the South Division High School for $6,641. The plumbing for the North Division school went to S. V. Hanley at 2,765 and, for the South Division school, to William [illegible]

J. Oscar Smith, Moberly, Mo., heating Virginia Building at Columbus, Mo., for $4,000. The Moline vacuum-vapor heating system will be installed.

BOOKS ON HEATING AND VENTILATION

Heating and Ventilating Buildings, a standard manual for heating engineers and architects. By Prof. R. C. Carpenter. Fifth edition, largely rewritten. 577 pages. [illegible] Ills., 8vo. cloth. $4.00

Baldwin on Heating; or Steam Heating for Buildings. By William J. Baldwin. [illegible]

Handbook for Heating and Ventilating Engineers. [illegible] $3.50.

Questions and Answers on the Practice and Theory of Steam and Hot Water Heating. By [illegible] Illustrated. [illegible]

Ventilation of Buildings. By William G. Snow and Thomas Nolan. 83 pages. Pocket size. Contains a statement of the general principles of ventilation and of their application to different kinds of buildings. Boards, 50c.

Steam Heating and Ventilation. By Wm. S. Monroe. Containing formulas and data valuable in the designing of heating and ventilating plants. Price, $2.00

Air-Conditioning. [illegible] treatise on the humidification, ventilation, cooling and the hygiene of textile factories—especially with relation to those in the U. S. A. With figures. 12mo. Illustrated. 143 pages. Price, $1.20.

Steam-Electric Power Plants. By Frank Koester. A [illegible] Power Stations and their economical construction and [illegible]

Light, Heat and Power in Buildings. By Alton D. Adams, M. E. The purpose of this volume is to present in compact form the main facts on which selection of the sources of light, heat and power in buildings should be based. The problem is to determine the kind of equipment that will yield the service required at the least cost. 12mo. Cloth, $1.00.

Practical Steam and Hot Water Heating. By Alfred G. King. Containing over 300 detailed illustrations. The book is a working manual for heating contractors, journeymen steam fitters, architects and builders. Describes various systems of heating and ventilation and includes useful data and tables for estimating, installing and testing such systems. 8vo. 367 pages. Price, $3.00.

Dean's System of Greenhouse Heating, by steam or hot water, with formulas for obtaining different temperatures, by Mark Dean. Price, $2.00

Power, Heating and Ventilation. By Charles L. Hubbard, [illegible] for designing and constructing engineers and architects. The whole subject of heating is covered, including the heating of large institutions with central plants. Space is also devoted to electrical matters connected with steam plants. 647 pages. Price, $5.00 (three volumes in one).

Notes on Heating and Ventilation. By John R. [illegible]

Hot-Water Heating and Fitting. By W. J. Baldwin Fourth edition. Price, $4.00.

Steam Fitters' Computation and Price Book, abridged. By Mark Dean. [illegible]

Practical Treatise Upon Steam Heating. By F. Dye [illegible] haust steam. 8vo, cloth, illustrated. Price, $4.00

The School House. Its Heating and Ventilation. By J. A. Moore. 204 pages, illustrated. $2.00.

A Manual of Heating and Ventilation, for engineers and architects, embracing tables and formulas for dimensions of pipes for steam and hot-water boilers, flues, etc. By F. Schumann. Second [illegible]

German Formulas and Tables for Heating and Ventilating Work, especially adapted for those who plan or erect heating apparatus. By Prof. J. H. Kinealy. Illustrated. Price, $1.00

Tables for Calculating Sizes of Steam Pipes. By Isaac Chaimovitsch. A manual for the determination of steam pipe sizes for low pressure heating. 48 pages. 4 insert tables. Price, $2.00.

Centrifugal Fans. By J. H. Kinealy. A theoretical and practical treatise on fans for moving air in large quantities at comparatively low pressures. 206 pages. 39 diagrams. Full limp leather pocketbook round corners, gilt edges. Price, $5.00.

The Principles of Heating. By William G. Snow. A practical and comprehensive treatise on Applied Theory in Heating. 161 pages. 42 illustrations. 38 tables. Size, 6x9 in. Cloth, $2.00.

Modern Sanitary Plumbing, Steam and Hot Water. By James J. Lawler. 400 pages. 228 illustrations. Size, 6x9 in. This is the latest edition of Mr. Lawler's [illegible] on this subject Price, $5.00

ADDRESS

The HEATING and VENTILATING MAGAZINE 1123 Broadway NEW YORK

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Loss of Pressure in Blowing Air Through Heater Coils, With New Formula

TESTS SHOWING IMPORTANCE OF POINT GENERALLY OVERLOOKED IN INDIRECT HEATING WORK

By E. M. Shealy,

Assistant Professor of Steam Engineering, University of Wisconsin.

In designing ventilating systems, it is necessary to know the resistance offered to the flow of air by the entire system of air passages, in order that the proper size of fan for delivering the required quantity of air may be determined. If a certain size of fan is installed and run at a certain speed, the quantity of air delivered will depend upon the resistance of the delivery system; the greater this resistance, the less will be the quantity of air delivered.

The resistance offered by various forms of piping used in ventilating systems is well known, and need receive no further attention here. Upon searching for information relative to the resistance offered by the heater coils, which forms a part of the delivery system of practically every ventilating installation, the writer found a surprising dearth of data. The little data which could be secured, although somewhat unreliable, pointed to the fact that the loss of pressure as the air passes through the heater coils amounts to a large portion of the total pressure generated by the fan.

When one considers that the path taken by air in passing through heater coils is very complex, winding in and out among the rows of pipe, and that the velocity of the air passing through the coils is usually high, from 800 to 1200 ft. per minute, it is not surprising that there is considerable loss of pressure in this part of the system.

To the writer's knowledge, some designers of ventilating systems neglect entirely the loss of pressure in the heating coils, assuming that it is so small as to be of no importance. Suppose this is done with a system in which the total pressure of the fan is only ½ oz. per sq. in. The loss of pressure in the heating coils might easily reach ¼ oz. per sq in., in which case only about one-half as much air would be delivered by the system as was intended. Neglect to allow for the loss of pressure in the heating coils explains why some ventilating systems are not giving satisfaction.

ARRANGEMENTS FOR TEST

Appreciating the need for more reliable data on the loss of pressure in heating coils, a series of tests were planned and carried out about a year ago with the object of securing definite information on this point. These

tests were conducted with a ventilating set consisting of a 48-in. steel plate fan run by a 10 H. P. electric motor, and a heater consisting of four two-row sections of 1-in. pipe spaced 2 in. center to center, which represents an ordinary type of heater. The coils were 6 ft. high and 5 ft. wide. The heater coils were encased in sheet iron, and were connected to the fan by a 40-in. circular galvanized iron pipe about 8 ft. long. The air was drawn through the heater coils, entering the fan at the center and discharging at the bottom into the ducts leading to the various rooms.

The general plan of the tests was to run the fan at a constant speed for each test, while the velocity of the air passing through the 40-in. pipe connecting the coils and fan was obtained with a Pitot tube, and, at the same time, the difference in pressure between various coils was measured with a manometer and tube. The above tests were made with different speeds of the fan, thus obtaining various velocities of air through the heater coils.

The motor used to run the fan was a direct-current shuntwound motor. It was connected with a rheostat in both field and armature, so it could be run at a predetermined and constant speed throughout any test. With a constant speed of the motor it was determined that the flow of air through the coils was constant.

The quantity of air passing through the 40-in. pipe, connecting the coils and fan, was measured at a point midway between the coils and fan. At this point the velocity of the air passing through the pipe was measured at 31 different points scattered over the cross-section of pipe. The average velocity of the air, multiplied by the cross-sectional area of the pipe, gave the number of cu. ft. passing per minute. The method of averaging the velocities is unique, and will be described later. The velocities were measured with the Pitot tube shown in Fig. 1, each branch being connected to a branch of a differential manometer. The difference in height of the liquid in the two branches of the manometer indicated the velocity.

HOLES BORED IN HEATER CASING TO OBTAIN PRESSURE

The loss of pressure in the heating coils was obtained by inserting

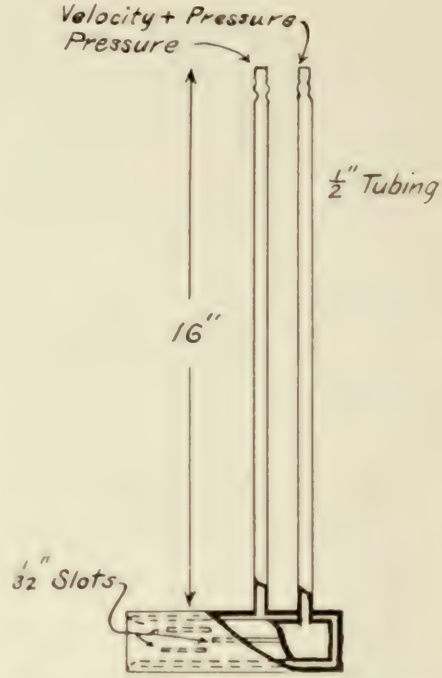


FIG. 1—ARRANGEMENT OF PITOT TUBE FOR MEASURING AIR VELOCITIES

through holes bored in the side of the casing, two brass tubes, ⅜-in. in diameter, having one end bent at right-angles, so it could be inserted between the pipes. The bent portion of these tubes had 1/32-in. holes in the sides, in such a position that when the tubes were inserted in the coils the holes came in line with the front of the row of pipes immediately preceding. The height of the casing was divided into six equal parts, and five rows of holes were bored through the side, midway of each part and extending across the casing, each row containing five holes. There was thus a row of holes for measuring the pressure between each of the four two-row sections, and one for measuring the pressure in front of the first row.

Eight readings of pressure were taken through each hole at spaced distances across the coils, thus obtaining

forty readings at each velocity and for each section. The average of these forty readings was taken as the average difference of pressure on the two sides of that particular coil. One tube remained in the first vertical row of holes, so as to measure the pressure in front of the entire set of coils, while the other tube could be moved back to include any number of sections, the two tubes being always in the same horizontal row when a reading was taken. By connecting each

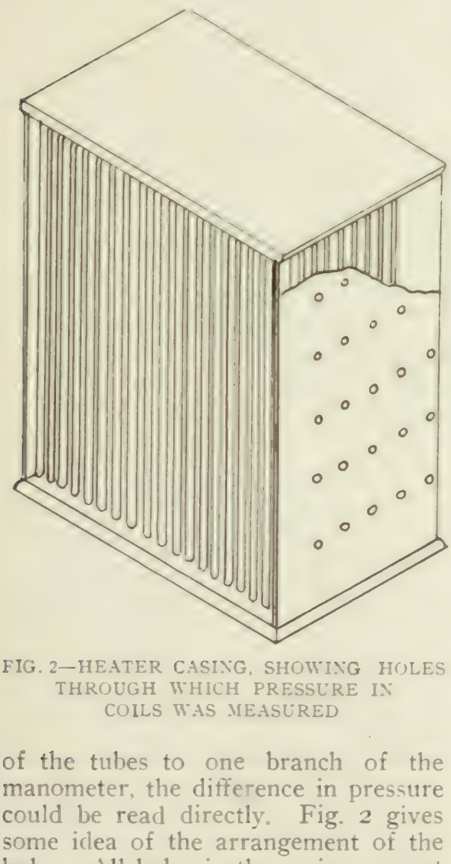


FIG. 2—HEATER CASING, SHOWING HOLES THROUGH WHICH PRESSURE IN COILS WAS MEASURED

of the tubes to one branch of the manometer, the difference in pressure could be read directly. Fig. 2 gives some idea of the arrangement of the holes. All holes in the casing, except the two which were being used, were stopped with corks.

Realizing that the difference in pressure, and, therefore, the difference in heights of the liquid in the manometer, would be very small, special differential manometers were constructed to secure greater accuracy. The same kind of manometer was used with both the pressure tubes and the Pitot tube. These manometers were made of ⅜-in. glass tubing, bent in the form of a U, and having an enlargement ⅞ in. in diameter at the top of each branch. The height of the glass U tube was 18 in., and it was mounted on a stout oak stand. A mirror was placed back of the U tube, being wide enough to extend under both branches, and a scale of inches and tenths was engraved with fine lines directly on the mirror. It could then be easily seen if the line of sight was directly in line with the meniscus of the liquid, thus obviating any error due to parallax, or the line of sight being above or below the meniscus. The liquids used in the manometers were, first, a mixture of two parts of toluene having a specific gravity of 0.866, and one part carbon titchloride, having a specific gravity of 1.63. This mixture, having a specific gravity of 1.12, was placed in the bottom of the manometer, and distilled water placed in the top. This gave a very clear and easily read meniscus, and it was found that a manometer constructed in this way multiplied the pressures about five times, giving great accuracy to the readings. The manometers were calibrated several times each day, to determine whether there was any change with age. It was found that after one week there was hardly any appreciable change.

Having determined the difference in pressure between the two sides of a heater section by the method described above, the corresponding velocity of the air through the heater was determined by dividing the number of cu. ft. of air passing through the heater per minute by the clear area of the heater. The clear area was obtained by subtracting from the total area of the heater the area occupied by a single row of pipes.

Ordinarily it might be expected that the velocity of air passing through a cross-section of the pipe connecting the heater with the fan would vary uniformly from the circumference towards the center, and that the point of maximum velocity would lie in the center of the pipe. It was found, however, upon exploring a cross-sec-

tion of the pipe about midway between the fan and the heater, that the velocity over a cross-section varied in a very erratic manner, there being an area of maximum velocity near one side of the pipe, and below the center. This was probably due to the position of the fan outlet, which was at the bottom, and discharging toward the side on which the area of maximum velocity lay. Since the velocity was so

The location of the points at which these velocities were taken was then plotted on a drawing of the cross-section of the pipe, drawn to scale, as shown in Fig. 3. Lines were then drawn through all points having the same velocity, and midway between these lines of equal pressures or contours, other lines not shown in the figure were drawn, which inclosed areas in which the velocities could be

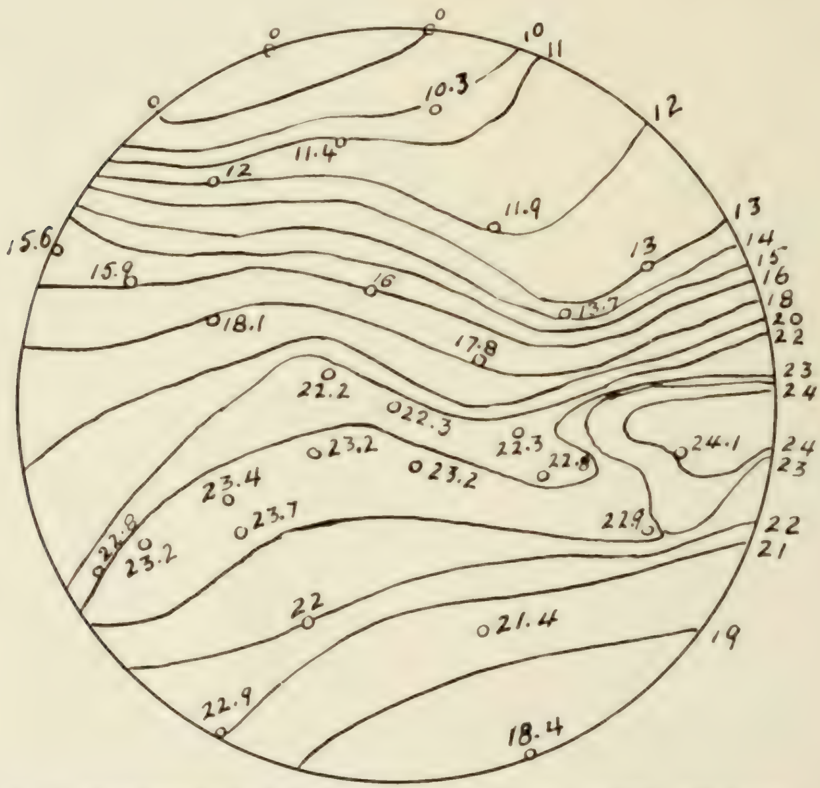


FIG. 3—THIRTY-ONE READINGS OF VELOCITY OF AIR PASSING THROUGH A CROSS-SECTION OF PIPE CONNECTING HEATER WITH FAN

variable over a cross-section, it would be impossible to find the average velocity by simply measuring the velocity at different points, and averaging them according to their position.

METHOD OF OBTAINING AVERAGE AIR VELOCITY THROUGH PIPE

In order to obtain the true average velocity, a series of 31 readings of velocity was obtained, while the speed of the fan remained constant, scattered over the entire cross-section.

considered as being the same as the contour lines through these areas. Then the sum of the products of these areas times the velocity in each, when divided by the total areas, will give the most probable true average velocity through the section. This was the method of obtaining the velocity of the air passing through the pipes, and from it the quantity passing. It was found in one case that the true average velocity, as calculated above, was

LOSS OF PRESSURE IN BLOWING AIR THROUGH HEATER COILS, AS DETERMINED BY TESTS

Velocity of Air through clear area Feet per Minute	Pressure Loss, ounces per square inch			
	Number of 2-row Sections			
	1	2	3	4
586	0.0057	0.0121	0.0169	0.0243
760	0.0099	0.0190	0.0232	0.0378
930	0.0145	0.0296	0.0394	0.0562
1000	0.0169	0.0332	0.0459	0.0640
1180	0.218	0.0441	0.0630	0.0910
1200	0.0244	0.0465	0.0725	0.0930
1280	0.0260	0.0545	0.0795	0.1050

926 ft. per minute, while, if calculated by simply averaging each velocity according to its position, the result would have shown a velocity of 1159 ft. per minute, which would have been an error of over 25%.

RESULTS OF TESTS

The results of the tests conducted, as outlined above, are shown in the following table, and are plotted in the form of curves in Fig. 4, for easier reference:

FORMULA FOR LOSS OF PRESSURE

From the results of these tests, as plotted in Fig. 4, it is seen that the pressure loss varies directly as the

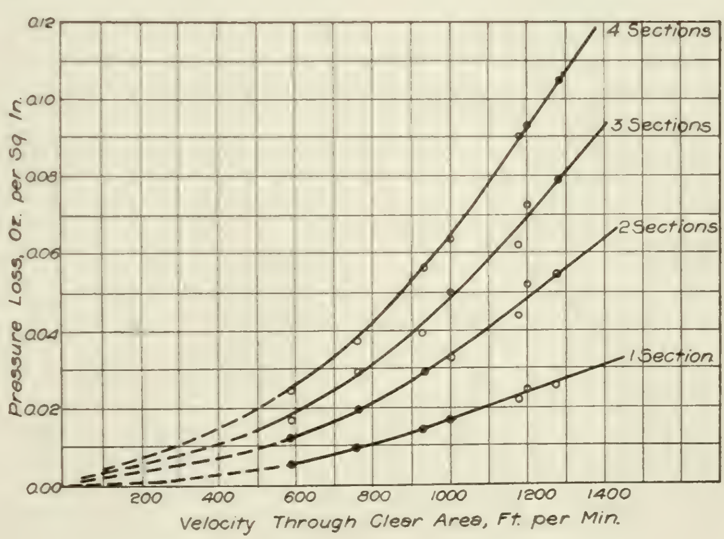


FIG. 4—RESULTS OF TESTS FOR LOSS OF PRESSURE IN BLOWING AIR THROUGH HEATER COILS

number of sections of heating coils, and also, approximately, as the square of the velocity of the air passing through the free area. The general form of equation for these curves is

$$y = mx^b \qquad (1)$$

Changing this to the logarithmic form gives

$$\log y = \log m + b \log x$$

The logarithmic values were plotted in order to find the values of m and b in equation 1, the equation giving a straight line with m as the intercept on the vertical axis, and b as the slope. This showed that for a two-row section the value of m was 0.0000000157 and varying directly with the number of two-row sections. Changing the equation back to its original form gives

$$p = 0.0000000157\, n\, v^{[illegible]}$$

in which p is the pressure loss in the coils expressed in ounces per sq. in.,

n is the number of two-row sections in the heater, and

v is the velocity of the air through the clear area, in ft. per minute.

From the above equation, the loss of pressure in blowing air through standard heater coils can be calculated if the quantities n and v are known or assumed. The results confirm what had long been suspected—namely, that if the loss of pressure in the heater coils is neglected in designing ventilating systems, the amount of air delivered by the system will fall far short of what is expected.

Great credit is due to Mr. N. J. Kayser, who took the data for these tests, for the painstaking care with which the work was done.

Heating Arrangements for an Extensive Group of Factory Buildings

The plant of the United Shoe Machinery Company at Beverly, Mass., for the manufacture of boot and shoe machinery, is the first factory constructed entirely of reinforced concrete, and stands to-day as the most extensive example of the use of this form of construction for machine-shop purposes in the country. The present floor area aggregates 600,000 sq. ft., and when the addition now being erected is completed the total floor space will be 744,000 sq. ft., or more than 17 acres.

The construction and arrangement of this plant was made the subject of an elaborate paper by L. P. Alvord, New York, and H. C. Farrell, Beverly, Mass., read before the American Society of Mechanical Engineers. The main buildings, originally 520 ft. long, are now 820 ft. Fig. 1 shows an outline plan of the buildings as they will be after the present additions are completed.

All of the buildings are connected by pipe and cable tunnels (Fig. 1), which enter underground chambers containing fans and heater coils for the indirect heating systems. Fig. 2 is a typical cross-section of the tunnel entering building A B X. The walls are used for piping, and beneath the floor are vitrified conduits for the electric cables. The floor of this tunnel pitches upward from the power house, and a gutter at one side receives any moisture that may enter any conveys it to a pump in the power-house basement, from whence it is pumped to waste.

The method of supporting the pipes in this tunnel was to bolt 6-in. by 8-in. hard pine posts to the inner walls. To the outer faces of these posts the pipe hangers are fastened by lag screws. These posts are spaced 10 ft. on centers,

The modifications of this tunnel over those originally planned consisted in increasing both the width and height in order to give more room to facilitate changes and repairs and in the use of hard pine posts instead of cast-iron slotted supports for the pipe brackets. The width of the original tunnel was 5 ft. in the clear; the new one 7 ft., and an average height of 7 ft.

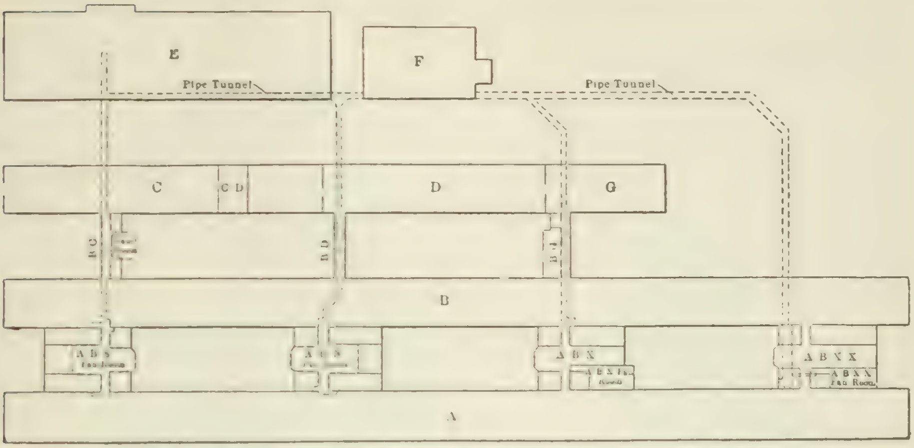


FIG. 1—PLAN OF UNITED SHOE MACHINERY COMPANY'S PLANT AT BEVERLY, MASS., AS IT WILL APPEAR WHEN PRESENT ADDITIONS ARE COMPLETED

At points just within the walls of buildings A and B (Fig. 1) will be noticed short connections from the tunnels which serve as a point from which pipe risers are conducted vertically upward through the buildings.

HEATING OF MAIN BUILDINGS

Fig. 1 also shows the underground fan chambers in each one of the main toilet-room wings. These chambers contain the heating engines, fans and coils for furnishing heat to the main machine-shop buildings, and storage building C. In the original plant 7990 sq. ft. of radiating surface is provided for each of the machine-shop buildings, or 1 sq. ft. of radiating surface for each 218 cu. ft. of room volume.

In this installation the ducts from the fans were carried outside of the buildings and connected underground to openings in the pilasters having the heating flues, by means of a flexible connection. The fan chambers under wings ABS and ABN contain, in addition to the fans for heating the main machine shops, fans for heating the toilet-room wings themselves.

In the older part of the plant it was difficult to maintain a suitable temperature at the north ends of the machine-shop buildings in severe winter weather. For this reason, the heating factor in the 1906-1907 addition was made 1 sq. ft. of radiating surface for every 130 cu. ft. of room volume. A certain amount of this increase was intended to provide for the lack of heating capacity in the older part of the plant.

Another change consisted in bringing the hot-air ducts within the building line, placing them close against the outer wall and making this roof a part of the ground floor slab. This has the beneficial effect of tending to increase the temperature of the ground floór itself.

The heating plants for the toilet-room wing ABX were omitted and direct radiation by wall coils substituted. Experience has demonstrated that all of these modifications were wise, and in the addition now under way the heating arrangements of the addition of 1906-1907 will be duplicated.

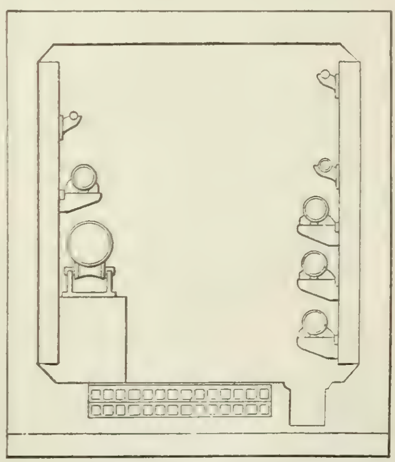
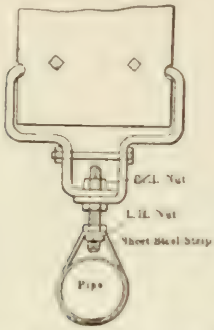


FIG. 2—TYPICAL CROSS-SECTION OF PIPE AND CABLE TUNNEL

Because of the large window area, no provision was made for mechanical ventilation in the main buildings, except that in extremely hot weather the heating fans are run to supply fresh, outside air through the heating system.



ELECTRIC WIRE SUPPORT AND PIPE HANGER

TOILET-ROOM WINGS

The toilet-room wings, designated in Fig. 1 by the letters ABS, ABN, ABX and ABXX contain locker rooms, wash rooms, toilet rooms, tool storage and delivery rooms, stair wells, and, as mentioned before, the connecting passageways between the main buildings.

All of the rooms are provided with mechanical ventilation, through a system of ducts in the walls leading to a chamber under the roof containing a direct-connected ventilating fan discharging to the outside air.

In the original building there was no local ventilation for the toilet-room utilities themselves, but it was provided in the additions. The improvement in conditions has been marked.

Two New Hot Blast Formulas

A typical instance of the advantages enjoyed by manufacturers of heating goods over those in the designing end of the business for procuring new and reliable information on engineering subjects is to be seen in the interesting data lately compiled by the Green Fuel Economizer Co., Matteawan, N. Y. The generosity with which the data are placed at the disposal of the public is not the least noteworthy feature of this company's latest production.

LOSS OF HEAD BY FRICTION OF AIR IN PIPES

On the subject of the loss of head by friction of air in pipes, which is one of the subjects treated in the book in question, which is entitled "Heating and Ventilation," the writer states:

Friction or resistance to the flow of air through a flue or conduit can be expressed as a negative head to be subtracted from the total head possessed by the air before passage through the pipe. The head lost in friction varies with the velocity, the roughness of the enclosing surface, curvature of the channel and the form of the cross-section; it also depends upon the viscosity, which varies with the temperature. Moreover, the drop in head follows at high velocities a law different from that holding for low velocities—that is, below the so-called critical velocity the drop is proportional to the velocity, while above the critical velocity it becomes proportional to the square of the velocity.

In flues of ordinary cross-section and with the velocities common in fan practice, the flow is turbulent—that is, above the critical velocity. For this condition the following expression for loss of head due to frictional resistance may be used—namely,

$$H_f = \frac{U^2 \, YLZ}{2g \, Q}$$

in which H_f is head in feet of air, U is the velocity in feet per second, g the acceleration of gravity, (= 32.17), Y a coefficient of friction, L the length of the pipe in feet, Z the perimeter of the pipe in feet, and Q the cross-section in square feet. Values of Y are given on the accompanying chart.

This gives the head lost in friction only and is not to be confused with the total loss of head required to force air through the pipe, since the head

required to give the fluid velocity through the pipe is ordinarily included in the latter. Also, it applies only to straight parts of the flue. Bends and obstructions in the pipe will cause additional losses of head.

$$H_b = \frac{U^2}{2g}(b_1 + b_2 + \text{etc.}), \text{ wherein}$$

b equals 1.1 for right-angled sharp corners,

0.3 for sharp angles of 135°,

0.25 for a right-angled bend of which the radius is equal to the diameter of the pipe,

0.15 for a right-angled bend of which the radius is 2 to 4 times the diameter of the pipe,

0.07 for a right-angled bend of which the radius is 5 to 6 times the diameter of the pipe,

Zero for bends of which the radius is more than 6 times the diameter of the pipe,

0.15 for a branch turning off at 135°,

1.5 for a grill or register of which the free area is one-half the total area and the free area is equal to the cross-section of the pipe line,

0.75 when the area of the register is 1½ times the cross-section of the pipe.

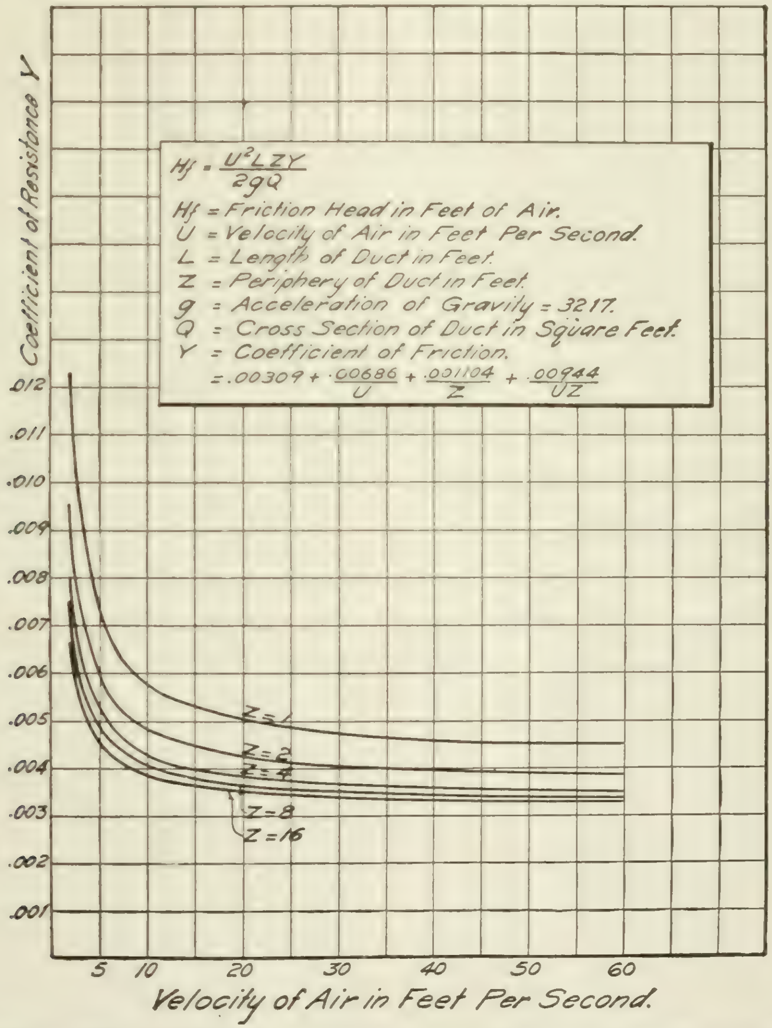


CHART GIVING COEFFICIENT OF FRICTION FOR SMOOTH SHEET IRON PIPES

When the free area of the grill or register is 0.2 that of the total grill, b = 2 when the free area is equal to the area of the flue and 1.0 when it is equal to 1½ times the area of the flue.

For sudden changes in the cross-section of the flue, $b = \left[\frac{Q_1}{Q_2} - 1 \right]^2$ in which Q_1 is the cross-section of the large pipe and Q_2 the cross-section of the small pipe, and b is used in connection with the velocity in the large pipe.

LOSS OF HEAD THROUGH ORIFICES AND EQUIVALENT ORIFICES

Since the head required to produce a given flow, S, of air through an orifice increases as the square of the flow, and since the head required to overcome the friction of bends, contractions and other obstructions in the air circuit also increases as the square of the flow, we may write the equation of the complete circuit as follows:

$$H = R S^2$$

wherein H is the total head required to force the volume S in cu. ft. per second through a circuit of which the total resistance is R. If R be expressed in appropriate units, 1 ft. head of air will produce a flow of 1 cu. ft. of air per second, through 1 unit of resistance.

Experiments made by W. N. Shaw indicate that such a unit or standard resistance would be that of an orifice in a thin plate of area a, where $a^2 = 1/27$ or $a = 0.189$ sq. ft. If the aperture is circular and of diameter d, then $\frac{\pi d^2}{4} = 0.189$, or $d = 0.498$ ft. In other words, a circular aperture of a diameter of about 6 in. will have unit resistance according to the above definition. Since the head consumed by resistance increases as the square of the velocity of flow, it will further appear that the resistance of an orifice varies inversely as the square of the area of the orifice.

When different resistances are passed in series by the current of air, the total resistance of the circuit is the sum of the pneumatic resistances of the several parts arranged in series. For instance, suppose a room to have on one side an inlet orifice 6 in. in diameter and on the opposite side an outlet orifice 1 ft. in diameter. The resistance of the inlet orifice, according to the above definition, will be 1. The area of the outlet orifice is four times as great as that of the inlet orifice, and the resistance will therefore be 1/16 and the total resistance encountered in forcing the air into and out of the room will be 1 1/16.

If air flows from one point to another by two different paths simultaneously, the drop in head over each path will be the same. If the resistance of the two paths are R_1 and R_2 respectively, we will have the equations

$$H = R_1 S_1^2$$

$$H = R_2 S_2^2 \text{ and}$$

also if the total flow is S we will have

$$H = R S^2$$

where R is the resistance equivalent to the combined resistances of the two circuits in parallel.

From these three equations we may easily deduce, since $S = S_1 + S_2$, the following:

$$\frac{1}{\sqrt{R}} = \frac{1}{\sqrt{R_1}} + \frac{1}{\sqrt{R_2}}$$

Then if we substitute for R, R_1 and R_2 their equivalents—namely,

$$\frac{1}{27 a^2}, \frac{1}{27 a_1^2} \text{ and } \frac{1}{27 a_2^2},$$

where a, a_1 and a_2 are the respective areas of the equivalent orifices we have, $a = a_1 + a_2$, or, in words, the combined air passing capacity of orifices or channels in parallel is the same as that of a single channel whose equivalent thin plate orifice is equivalent in area to the sum of the areas of the equivalent thin plate orifices for the separate channels.

We may, therefore, speak of the thin plate orifice equivalent to the resistance of a mine, although the mine may contain many passages in parallel and series. Or we may speak of the equivalent orifice of a duct or of a complex ventilating system, or the equivalent orifice corresponding to the grates, the fuel on the grates, the

boiler passages and the chimney of a steam boiler plant. Or, if we know the equivalent orifices of the several parts which are arranged in series and in parallel, we can easily calculate the equivalent orifice of the whole.

Before leaving this subject, it will be well to point out just what the unit of equivalent orifice is. Shaw's experiments are based on the use of a circular orifice in a thin plate, and a comparison of his formula

$$H = \frac{1}{27\,a^2} \times S^2,$$

with the formula for falling bodies

$$U^2 = 2g\,H,$$

wherein g = acceleration of gravity and U = velocity in ft. per sec., will show that the coefficient of this thin plate orifice works out as 0.653. That is, only 65.3% as much air is passed through the orifice as would be passed if the whole orifice were occupied by a stream moving with the velocity U theoretically due to the head H. Orifices of different shapes and with different conditions of approach or efflux, have different coefficients. For instance, if the up-stream side of the flat plate is roughened, as by pasting sand paper on it, the coefficient will be increased—that is, more air will flow through under a given head. On the other hand, if the up-stream side be provided with a raised edge the coefficient will be reduced to about 0.5. If the collar is on the discharge side, however, and is extended to form in effect a long pipe, the coefficient will be increased to a value approaching 0.83.

Heating and Ventilating Concrete Buildings

Scarcely anything could be imagined that would be more likely to bring about the desired intimate association of the architect with the heating and ventilating engineer than an increased adoption of ferro-concrete in the construction of large buildings.

It has been pointed out that reinforced concrete building restricts the "air leakage" which is usual when other materials are employed. On the other hand, heat transmission through ferro-concrete walls is more rapid than through brick walls, partly owing to the better heat conductivity of the material, but more to the decreased thickness of the walls.

Let it be taken for granted, as we may reasonably do, that a public demand for ferro-concrete construction will certainly, if slowly, extend; then it will be seen that numerous advantages fall to the engineer—relatively small in themselves, perhaps, but possessing a cumulative value that will have an important bearing on the two essentials already stated, of the unrestricted acceptance, and full efficiency in subsequent working, of the engineering installation.

In the first place, very careful and complete architectural consideration must be paid to the heating and ventilating scheme along with the preparation of the plans. Flues and ducts cannot be concealed in thin ferro-concrete walls. Floors and walls must be planned for their admission beforehand, to avoid any considerable cutting through the hard concrete, with its vitally important arrangement of the reinforcement. In view of the fact that there will be no "roof space" in large concrete buildings, as is required by some heating and ventilating schemes, definite architectural provision must be made for running the pipes. There will also occur at times a practical difficulty in conveying the vertical pipes and flues, when, as in steel-frame buildings, division walls are not continued up and down from floor to floor. At almost every turn it will be found that need will arise for close collaboration between the architect and the engineer—a necessity which must tend materially to the soundness and completeness of the engineering scheme, making it, in fact, a recognized integral part of the entire architectural conception.

Then there will also be advantages in the direction of reducing the cost of the installation. Economy will be

further increased by forming the ducts entirely of reinforced concrete—that is to say, doing away with all brickwork, making the ducts practically air-tight, and so minimizing the heat losses in transit—a reduction which will be furthered by the formation of proper curves and angles which have not been easily possible in brickwork. Concrete ducts will also be cheaper to construct, and this fact should induce architects to view them with greater leniency than formerly.

A further advantage to the engineer will be found in the method of laying the floors as the work proceeds, instead of waiting for the building frame to be first completed. These are typical instances of the changes involved in the adoption of reinforced concrete in main buildings. In many minor respects, further advantages, all tending both to economy and to efficiency, will be found in the adoption of the new medium for the construction of such matters as chimney stacks, water storage tanks, "sumps," foundations for machinery, air inlet and outlet shafts, etc.

As ferro-concrete tends to more rapid construction than brickwork, and much more rapid than stonework, the consequent saving in first cost is allied to the many other advantages already recognized. The disadvantages, chiefly of an æsthetic nature, architects will be called upon to overcome. Its widespread adoption is but a question of time. Engineers have already to reckon with it very seriously. Heating operations will be facilitated by it; but the many complex questions that already arise on every "job" will, in all probability, be further complicated by a new and at present unknown factor.

An impervious material, such as this has not yet been fully dealt with scientifically in its relation to health-giving air inclosed by it. At this point the ventilating engineer is called upon with no little urgency. That he will rise to the opportunity none will doubt who has followed him from stage to stage in the last twenty years' expansion of his business.—*F. G. Stevens.*

Do Gas Lights Contaminate Air?

Following closely upon the doubts expressed as to the value of the carbon dioxide test for determining the purity of air, the statement is now made that gas lighting, so far from having a deleterious effect upon the air in a room, has a positively beneficial effect upon such air in adding to its hygienic value. Just how this is accomplished is explained by R. F. Pierce, in *The Illuminating Engineer.* One of the greatest advantages of gas lighting, he states, and one that strangely enough has received little or no attention, is the highly beneficial effect upon the quality of the air in illuminated interiors. As this effect is not at all obvious, but, on the contrary, the reverse would, upon casual consideration, appear to be true, it is highly desirable that the facts in the case be set forth in such a manner as to admit of the rational comparison of different illuminants in this respect.

Many people carelessly and unthinkingly assume that because the burning of a gas light discharges products of combustion into the room, a perceptible vitiation of the atmosphere must result. As a matter of fact, the precise reverse is the case, and this fact really constitutes one of the greatest advantages to gas over electricity for illuminating purposes.

The combustion of gas produces, from a chemical standpoint, four different effects upon the air taken from the room, mixed with the gas in the burner and discharged back into the room.

These effects are:

First.—The amount of oxygen is reduced.

Second.—The amount of carbonic acid gas (CO_2) is increased.

Third.—A very small amount of sulphurous gas (SO_2) is generally added.

Fourth.—Organic impurities and

deleterious substances are removed by incineration.

The first, second and third effects are caused by the oxygen combining with the carbon and sulphur contained in the gas, and this oxidizing process generates heat in sufficient quantities to raise the mantle to the temperature of incandescence—about 1500° F., which is sufficient to produce the fourth effect.

The physical effects produced upon the air are:

First. — The temperature is increased.

Second.—The circulation of the air in the room is accelerated and the ventilation from the outside is increased.

As the quality of the air in the room at any time depends upon the interaction of the incoming fresh air upon the products of combustion discharged from the burners and the organic matter exhaled from the lungs and skin of the inhabitants of the room, it is necessary to investigate the inter-effects of all three.

On account of the tendency of heated air to expand, become lighter and rise, the presence of any source of heat in a room produces a certain circulation of the air, which serves a double purpose. In the first place, the heated air is cooled by contact with successive portions of the relatively cool walls, and in the second place the temperature in the upper portions of the room tends to increase, while that in the lower portion tends to decrease below that which would prevail without circulation. This produces an unbalanced pressure from the outside, tending to draw fresh air in at the bottom of the room through crevices, joints and other openings, and also to a greater extent than is ordinarily realized through the walls themselves. The same action tends to expel the air in the upper portion of the room in the same manner, and this tendency is, of course, greatly augmented by increased facilities for ventilation.

As a gas lamp produces about six times as much heat as a Magda or tungsten lamp of equal illuminating power, it follows that the ventilating effect is correspondingly greater. At first thought it might appear that the use of gas lamps for ventilating purposes would be very inefficient, and that their effect would be practically negligible.

While positive assurance derived from actual installations is submitted later on, it may be well to call attention at this point to the fact that in many chemical laboratories, where the air is being constantly vitiated by noxious vapors, the principal means of exhausting the contaminated air is through the use of an open gas jet placed in a suitable vent. The ventilation produced must, of course, be far more effective than that required for any ordinary purpose, as the contamination of the air is exceptionally rapid.

Of course, in making use of the ventilating properties of gas burners, a balance must be struck between the amount of radiant heat generated and rapidity of ventilation. It does not follow that the foulness of the air is always decreased by increasing the amount of heat generated in the room. This is, of course, perfectly obvious. The writer only purposes showing that under the conditions usually met in lighting practice the substitution of gas for electric lighting will generally produce this effect—other conditions being equal.

In considering the concurrent effects of light sources and the incoming air upon the average quality of the interior air at any moment, it is necessary to inquire into the nature and effects of the vitiating substances. Generally speaking, these are divided into two classes: Those emitted by the respiration, both from the lungs and the skin of the people in the room; second, those emitted by the illuminants. The first class includes germs of those diseases which are transmitted by germs, which, when taken from the air into the system through the mouth or skin, will produce their characteristic diseases. As a matter of fact, the supposedly fresh air from the exterior is often heavily laden with germs of this character.

More commonly than any other are felt the effects of the vitiation pro-

duced by the organic matter in a greater or less advanced stage of decay exhaled by the lungs. This produces the stuffiness in a poorly ventilated room which is sometimes ignorantly attributed to carbonic acid gas.

As between gas and electric lighting, the former is the only one contributing any products of combustion whatever, and these are as follows: First, carbonic acid gas; second, sulphurous acid gas; third, water.

On account of the ability of gases to diffuse through even the tightest walls used in building construction, the proportion of carbonic acid gas in interiors rarely rises above 20 parts in 10,000, though for experimental purposes this proportion has been made as high as 50 parts in 10,000. This was accomplished only by resorting to exceptional means to secure a high percentage of this gas. Thus, practically speaking, it may be said that it is impossible in practice to obtain enough carbonic acid gas in an ordinary room to produce the slightest effect upon the bodily functions, even when the most sensitive tests are employed to detect such effects.

Sulphurous acid gas, when present, is in such almost infinitesimal quantities that it is disregarded by investigators, as far as effects on the health are concerned, though unscrupulous or ignorant salesmen of lighting apparatus frequently attempt to make capital of it. While it is in the quantities found entirely harmless to the human organism, it has a decided sterilizing effect as regards disease germs, which will be referred to later.

While it is true that carbonic acid gas artificially produced—that is, by gas combustion—is entirely innocuous in any quantity met with in human habitations, it must not be assumed that such quantities of this gas exhaled from the lungs may be regarded as an indication of sanitary conditions. On the contrary, even 15 parts of carbonic acid gas in 10,000, if arising from respiration of human beings, indicates the presence of organic matter in such quantities as to be highly obnoxious or even harmful.

In this connection it should be noted that the vitiation of air by human beings is generally expressed as percentage of carbonic acid gas, because it indicates the amount of organic matter which has been given off in the same period; and while the latter (which is the real source of pollution) is difficult to measure, the carbonic acid gas is easily determined.

From a sanitary standpoint, therefore, figures regarding the quantities in which carbonic acid gas indicates harmful conditions apply only to this gas when thrown off by the lungs, and not to the same gas produced by artificial means, such as the operation of gas lights.

It is evident that the absurd practice of rating each gas burner as equal to a certain number of human beings in vitiating the air in interiors is not only highly ridiculous, but precisely opposite to the dictates of common sense and the testimony of established facts; for, as will be shown later, the presence of gas burners actually removes the vitiating matter.

In order to substantiate the statements made above, the following extracts from the reports of competent authorities and experimenters are submitted.

TESTS WITH GAS AND ELECTRIC LIGHTS

Probably the most extensive, painstaking and intelligent reports upon the relative hygienic value of gas and electric lighting were those made by Samuel Rideal, D.Sc., F.I.C., a report of which was contributed to the *Journal of the Royal Sanitary Institute*, published in Vol. XXIX, No. 2.

This investigation was carried over a considerable period of time in a room provided with both gas and electric lights, the former from inverted incandescent burners and the latter from incandescent electric lamps.

These experiments were made in an office building at No. 28 Victoria street, London, in a room 29 ft. 9 in. x 16 ft. 4½ in. x 10 ft. 4 in., and covered a considerable period of time. Exceptional pains were taken to see that the inmates of the room were all healthy and could be classed as fair physiological examples of men living and working in London, and every

care was taken to exclude those affected with transient catarrhal or other symptoms likely to affect the results of the experiment.

The experiments covered a wide range of conditions, and the tests included frequency and character of pulse, as shown by the sphygmograph, frequency of respiration, arterial blood pressures, variation in the number of blood corpuscles, body temperatures, body weight, mental fatigue, time reaction, etc. The physical and chemical determinations included the change in temperatures, due to the different illuminants, rapidity of ventilation, content of carbonic acid gas, number of bacteria, amount of organic matter, relative humidity, etc. The amount of gas consumed and its calorific value was carefully determined, as well as the input of the electric lamps. The illuminating power of the gas burners was considerably in excess of that of the electric burners, as was determined by photometric test.

The report comprises over 80 pages, and in the limited space available here it is obviously impossible to reproduce the data with sufficient entirety for the reader to criticize or analyze it satisfactorily. The following extracts from the summaries of this investigation are given herewith.

An accompanying table gives a summary of the average temperatures at the beginning and end of the runs.

The results of these tests show plainly that the difference between gas and electric light on the temperature of the room was negligible.

TABLE SHOWING EFFECT UPON ROOM TEMPERATURES OF GAS AND ELECTRIC LIGHTS

	Gas				Electric			
	No. of	Degrees F.			No. of	Degrees F.		
Arrangement	runs	Initial	Final	Rise	runs	Initial	Final	Rise
Restricted ventilation:								
*Undivided room	22	53.6	57.0	3.4	18	54.0	57.2	3.2
Divided room	6	59.0	63.4	4.4	6	58.7	62.9	4.2
Fireplaces and ventilators open:								
Divided room	2	60.8	63.9	3.1	2	59.2	62.7	3.5
Fireplaces, ventilators, doors and windows open.								
Divided room	2	58.4	57.5	—0.9	2	58.3	56.9	—1.4

*During the series of experiments, the room was divided into two equal and symmetrical parts by a wooden partition in a number of the tests.

As regards the presence of organic matter in the air, the figures below are expressed in volumes of oxygen consumed per million volumes of air for the oxidation of the organic matter.

Thus the increase under electric lighting during the day in the undivided room was about 50% greater than that under gas light. In the undivided room the increase under electric light over gas light was somewhat greater.

As regards the bacterial contents of the room, Dr. Rideal stated that the following factors would all tend toward lessening the bacterial content with gas lighting as against electricity:

First.—The cremation of organisms in the flames.

Second.—The sterilizing effect of the sulphur acids in the gas.

Third.—The increased condensation on the cold surfaces, removing organisms as well as the sulphur products.

RESULTS OF TESTS FOR PRESENCE OF ORGANIC MATTER IN THE AIR

	Air Outside	Room 5:45 p. m.	Room 9:00 p. m.	Rise
Undivided room:				
Average total	2.8	4.9	8.8	....
Average total gas	...	5.3	9.0	3.7
Average total electric	...	4.0	9.8	5.8
Divided room:				
Gas	...	...	...	2.7
Electricity	...	...	...	4.7

Fourth.—Any increased ventilation of the room.

The organisms falling by gravity and air currents were determined by the exposure of nutrient gelatine plates for a definite time in various positions in the rooms, and a reduction of 29.2 was obtained under electric light, as against 35.3 under gas light. Obviously, in this test the ventilation was a most important factor, as these organisms were for a great part deposited upon the plates before having an opportunity of passing through the flames of the gas burner.

Another test was made of the organisms per cubic centimeter in the condensed moisture. The following table sets forth the results of this test, showing that while the sterilization of the air passing through the gas burner was entirely complete, no sterilizing action existed under electric light:

ORGANISMS PER CUBIC CENTIMETER IN CONDENSED WATER

Electric Light

Date 1907	Start	Finish	Persons in room
February 6........	12	15	8
February 18........	26	18	8
February 26........	..	9	1

Gas Light

Date 1907	Start	Finish	Persons in room
February 11 .	4		8
February 15 .	6		9
February 27........	..		4

It may be well to call attention to the fact that at this point the condensed moisture carried but a small percentage of the bacterial organisms into the air, and while the entire absence of such organisms in the condensation under gas light would indicate a very complete sterilization of the air, it by no means follows that the number of organisms present in the water condensed under electric light give a very satisfactory indication of the number of organisms existing in the air, as only a small portion of the bacteria would be found in the condensed water.

As regards the ventilating effect, it was found that the percentage of carbonic acid gas was practically the same for both gas and electricity, showing that the gas burners have sufficient power to produce a ventilation adequate to remove the excess of carbonic acid gas produced. With ordinary ventilation the excess disappeared entirely, while with the poorest ventilation the slight excess of carbonic acid gas under gas light was practically negligible.

CO_2 PARTS IN 10,000 DURING STEADY STAGE

Divided room	Gas	Electric
Fireplaces and ventilators closed.................	41.1	31.1
Fireplaces and ventilators open	19.4	19.3
Fireplaces, ventilators, doors and windows open..	8.7	7.2

In the general summary, Dr. Rideal stated that gas burners give rise to stronger air currents and invariably produce a more active ventilation and diffusion of air than electric lights; hence, along with the products of the gas burner, the exhalations of the persons present were more rapidly removed. Second, the ascending currents of air from the gas lights on reaching the ceilings rapidly parted with their heat, which was conducted away by the rafters and joists. Third, the electric lamps produced more heat than is commonly accredited to them, and that this is the explanation of the unexpected result that the average temperature of the room was practically the same under either illuminant, and the electric light did not show the superiority in coolness usually claimed.

While the careful and exhaustive tests of Dr. Rideal would appear to be most convincing as regards the absence of the obnoxious products sometimes ignorantly attributed to gas burners, it may be worth while to note, for the benefit of the ultra-skeptical, that nearly all competent authorities agree that even if the CO_2 contents of the air were increased (which is not the case) such increase could not produce ill effects.

Dr. Angus Smith shut himself in an air-tight chamber with a lighted candle and remained until the candle was extinguished by the high CO_2 content produced (229 parts in 10,000). He felt no ill effects.

Dr. Richardson removed all the CO_2 from air that had once been breathed, and found that animals introduced into such air dwindled away rapidly and died.

Pettenkofer found that 100 parts of CO_2 in 10,000 parts of air was not injurious to human beings, while one-tenth the amount of CO_2 derived from lung and skin exhalations rendered the air unfit for human habitation for any length of time.

It would seem, therefore, that the scare of increased CO_2 content from gas burners may not only be said to exist only in the imaginations of interested exploiters of competitive illuminants, but, furthermore, if it did exist, would be perfectly harmless.

Review of Heating Literature

EDITOR'S NOTE—*A constant demand for back numbers of* THE HEATING AND VENTILATING MAGAZINE *which were long since out of print has led the publishers to feel that the reproduction of some of the more important matter appearing in these numbers would be welcomed by all our readers. Accordingly, we have arranged to publish under this heading a few of the more noteworthy articles which are no longer obtainable in the issues that contained them.*

I—GREENHOUSE HEATING CHARTS

By JOHN A. PAYNE

The charts herewith presented were made to meet the average conditions found in connection with greenhouse heating with the outside temperature at zero, and have been found reliable in actual practice. They are intended to be used for houses having an eave line up to about 6 to 7 ft.

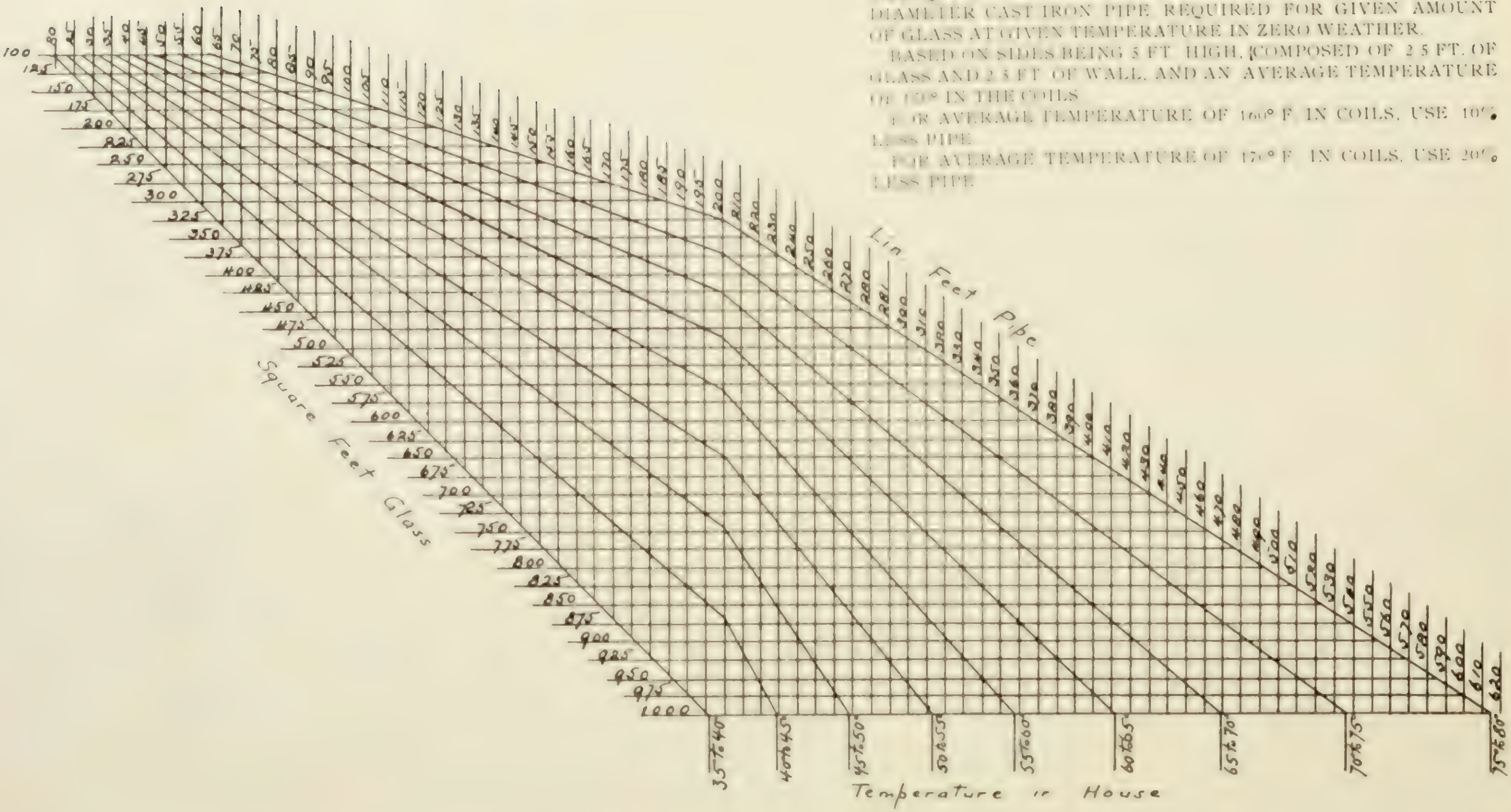
In the case of specially well built houses the amount of surface may be reduced about 7%. Where the cubical contents of the greenhouse are large in comparison with the glass surface the amount of surface given in the charts may be correspondingly reduced. It is safe to say that for a house of 25 ft. wide and 75 ft. long, with the eaves 10 to 12 ft. high, the surface specified in the charts may be reduced fully 10%.

The amount of surface given in the charts is based upon the assumption that the water in the pipes will have an average temperature of 150° F. If this temperature is increased to 160° the amount of surface may be decreased 10%. If it is increased to 170°, the surface may be decreased 20%.

As stated, the surface given in the charts is for a temperature of zero outside, but it may be made to answer for other outside temperatures by the use of Table 1, as follows: Assuming that it is required to heat a house containing 600 sq. ft. of glass to between 35° and 40° when the outside temperature is 10° below zero, we see by Table 1 that this would be equal to heating the same house to between 40° and 45° at zero.

TABLE 1.—RATIO FOR OUTSIDE TEMPERATURES, OTHER THAN ZERO.

35	to	40	at	+ 10	=	30	to	35	at	0
35	"	40	"	— 10	=	40	"	45	"	0
35	"	40	"	— 20	=	45	"	50	"	0
40	"	45	"	— 10	=	35	"	40	"	0
40	"	45	"	— 10	=	45	"	50	"	0
40	"	45	"	— 20	=	50	"	55	"	0
45	"	50	"	— 10	=	40	"	45	"	0
45	"	50	"	— 10	=	50	"	55	"	0
45	"	50	"	— 20	=	55	"	60	"	0
50	"	55	"	— 10	=	45	"	50	"	0
50	"	55	"	— 10	=	55	"	60	"	0
50	"	55	"	— 20	=	60	"	65	"	0
55	"	60	"	— 10	=	50	"	55	"	0
55	"	60	"	— 10	=	60	"	65	"	0
55	"	60	"	— 20	=	65	"	70	"	0
60	"	65	"	— 10	=	55	"	60	"	0
60	"	65	"	— 10	=	65	"	70	"	0
60	"	65	"	— 20	=	70	"	75	"	0
65	"	70	"	— 10	=	60	"	65	"	0
65	"	70	"	— 10	=	70	"	75	"	0
65	"	70	"	— 20	=	75	"	80	"	0

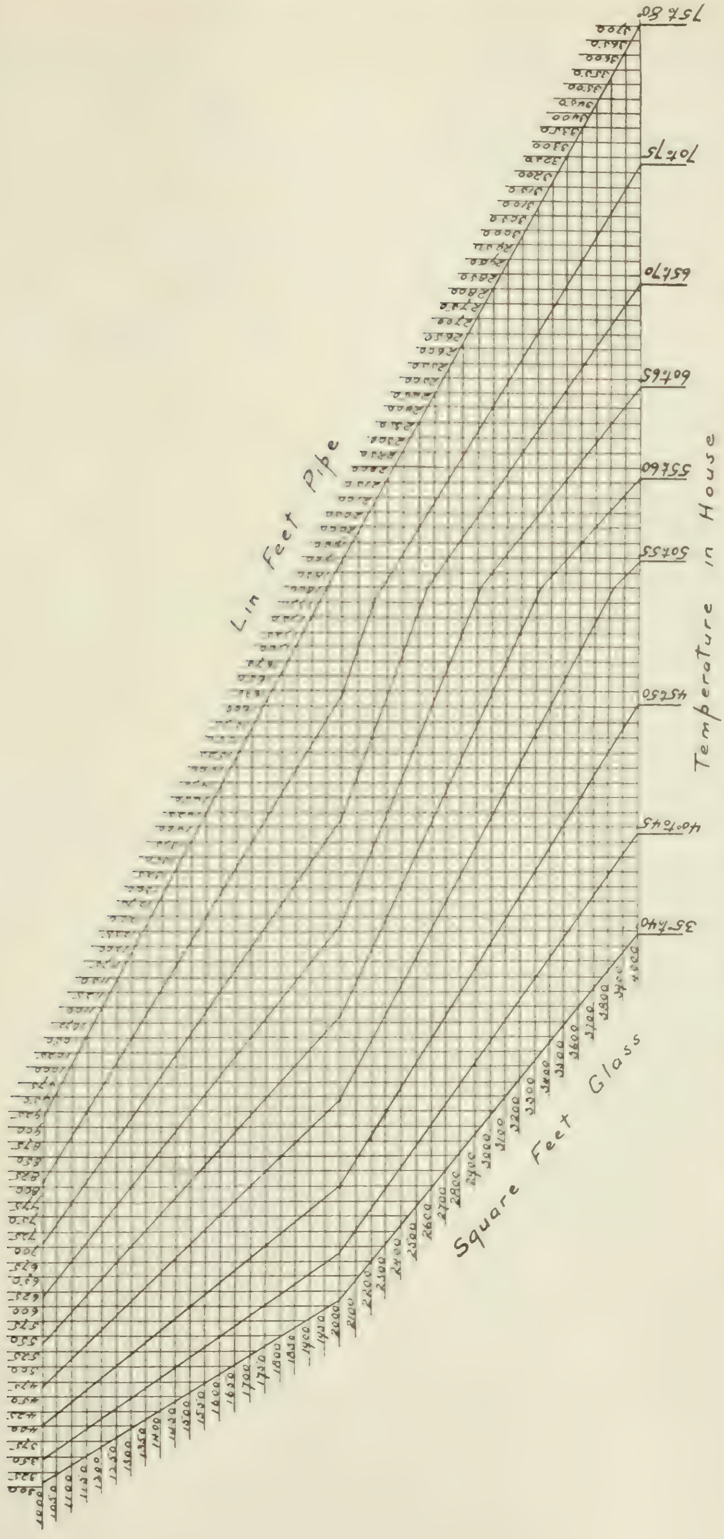


GREENHOUSE HOT WATER HEATING CHART No. 1. 100 TO 1000 SQ. FT. GLASS SHOWING LINEAL FEET OF 3½-IN. INSIDE DIAMETER CAST IRON PIPE REQUIRED FOR GIVEN AMOUNT OF GLASS AT GIVEN TEMPERATURE IN ZERO WEATHER.

BASED ON SIDES BEING 5 FT. HIGH, COMPOSED OF 2.5 FT. OF GLASS AND 2.5 FT. OF WALL, AND AN AVERAGE TEMPERATURE OF 150° IN THE COILS.

FOR AVERAGE TEMPERATURE OF 160° F. IN COILS, USE 10% LESS PIPE.

FOR AVERAGE TEMPERATURE OF 170° F. IN COILS, USE 20% LESS PIPE.

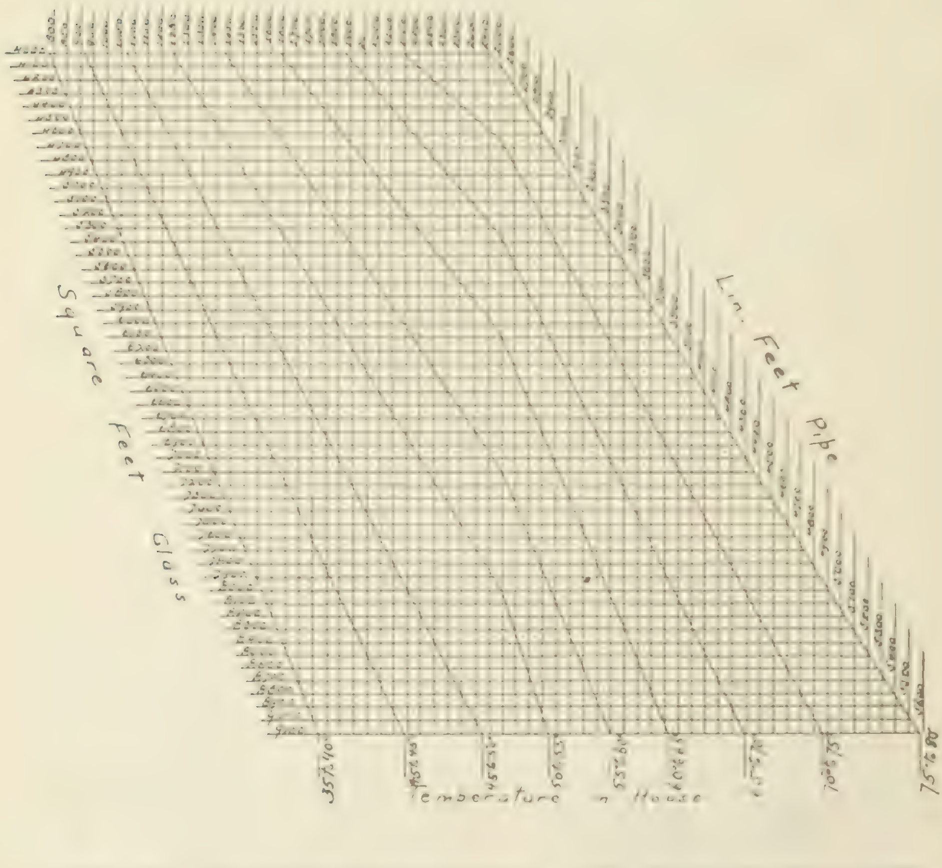


GREENHOUSE HOT WATER HEATING CHART No. 2, 1000 TO 4000 SQ. FT. GLASS, SHOWING LINEAL FEET OF 3½-IN. INSIDE DIAMETER CAST-IRON PIPE REQUIRED
CONDITIONS SAME AS FOR CHART No. 1

On referring to Chart 1 we find that the line for a temperature of between 40° and 45° in the house intersects the 600 sq. ft. glass line at the point between the line indicating 135 and the line indicating 140 lin. ft. of 3½-in. pipe; therefore, 130 ft. of 3½-in. pipe, with the water at an average temperature of 150°, will be sufficient to maintain 35° to 40° in a house of this size when the outside temperature is 10° below zero.

Of course, it is impossible to anticipate in a chart all imaginable conditions and it is necessary to exercise some judgment in the use of these charts and to make allowance for extra cold weather, specially exposed locations or other extraordinary conditions.

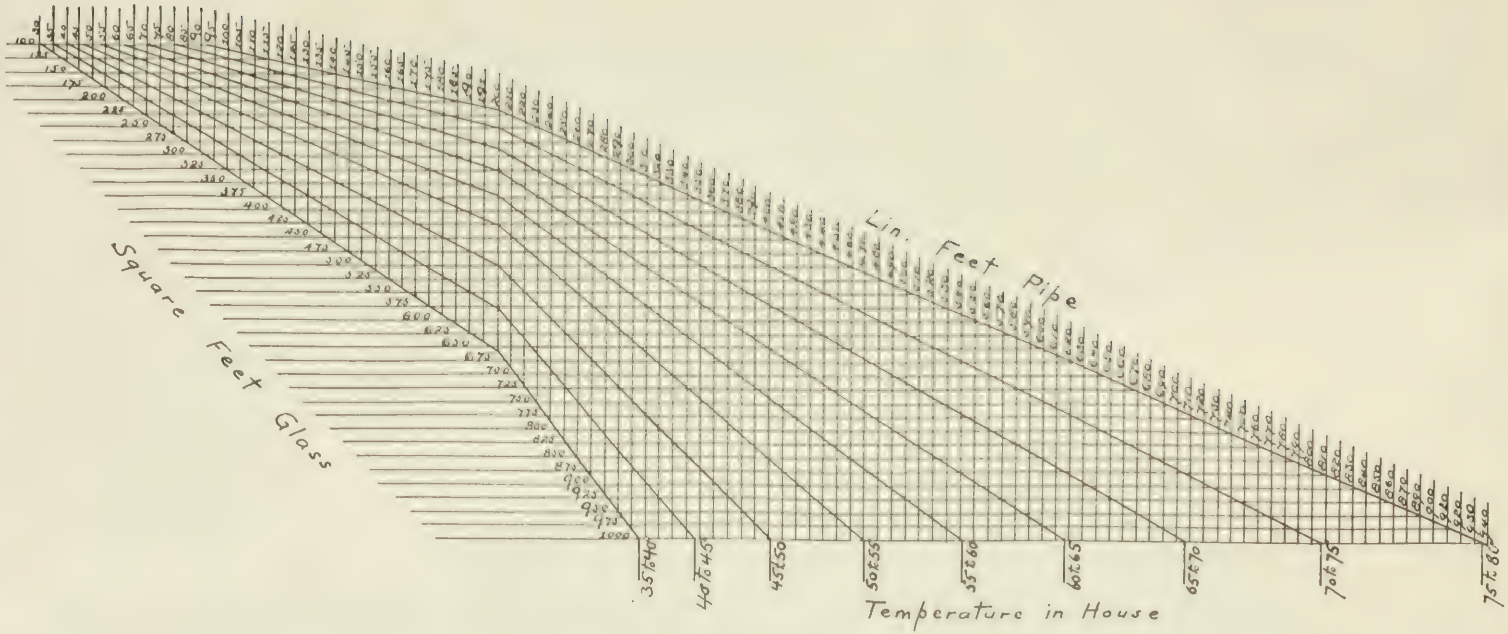
I believe, however, that the charts, as I have given them, embodying as they do the experience of years, will be found of value to engineers in estimating greenhouse heating jobs.



GREENHOUSE HOT WATER HEATING CHART No. 3, FOR 4000 TO 9100 SQ. FT. GLASS, SHOWING LINEAL FEET OF 3½-IN. INSIDE DIAMETER

CAST IRON PIPE REQUIRED

CONDITIONS SAME AS FOR CHART No. 1



GREENHOUSE HOT WATER HEATING CHART No 4, 100 TO 1000 SQ. FT. GLASS, SHOWING LINEAL FEET OF 2-IN. INSIDE DIAMETER WROUGHT IRON PIPE REQUIRED FOR GIVEN AMOUNT OF GLASS AT GIVEN TEMPERATURE IN ZERO WEATHER

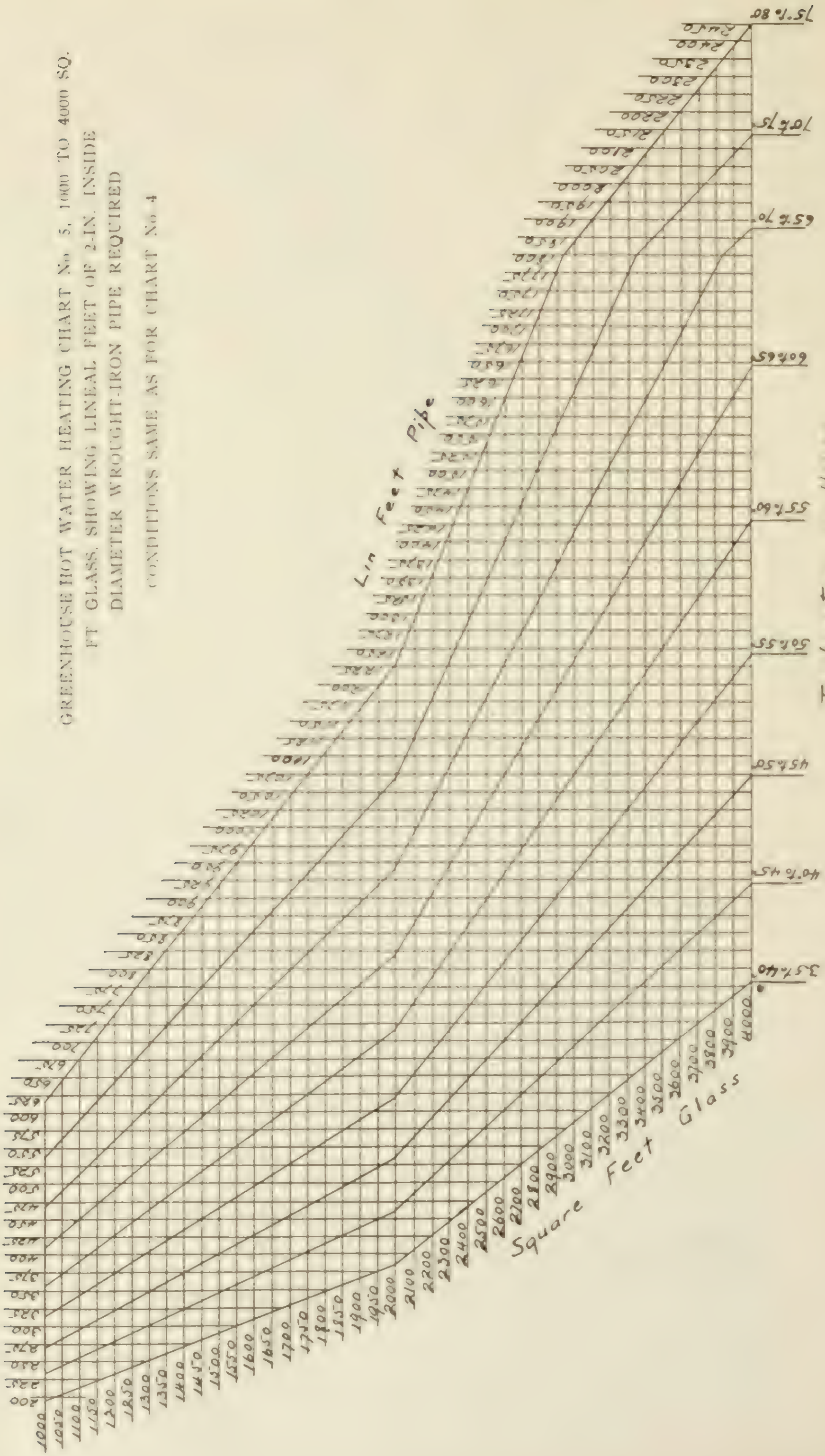
BASED ON SIDES BEING 5 FT. HIGH, COMPOSED OF 2.5 FT. OF GLASS AND 2.5 FT. OF WALL AND AN AVERAGE TEMPERATURE OF 150° F. IN THE COILS

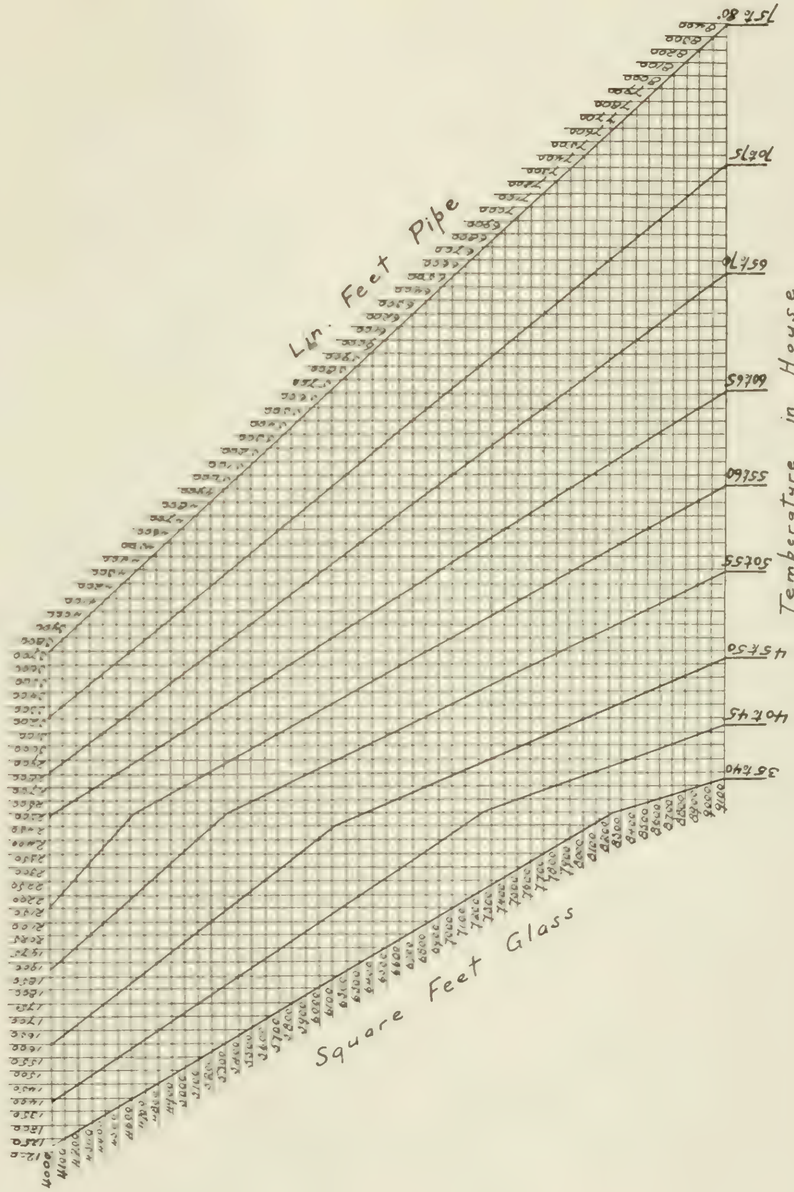
FOR AVERAGE TEMPERATURE OF 160° F. IN COILS, USE 10% LESS PIPE

FOR AVERAGE TEMPERATURE OF 170° F. IN COILS, USE 20% LESS PIPE

GREENHOUSE HOT WATER HEATING CHART No. 5, 1000 TO 4000 SQ. FT GLASS, SHOWING LINEAL FEET OF 2-IN. INSIDE DIAMETER WROUGHT-IRON PIPE REQUIRED

CONDITIONS SAME AS FOR CHART No. 4





GREENHOUSE HOT WATER HEATING CHART No. 6. 4000 TO 9100 SQ. FT. GLASS, SHOWING LINEAL FT. OF 2-IN. INSIDE DIAMETER WROUGHT-IRON PIPE REQUIRED

CONDITIONS SAME AS FOR CHART No. 4

Modern Design in Hospital Heating

Some frank opinions on the prevailing methods of heating and ventilating hospitals, as well as some new "wrinkles" now being tried out in this class of work, were discussed by Clarence W. Williams, speaking before the American Hospital Association at its annual meeting in New York. Only such systems as are applicable to the larger institutions were considered by Mr. Williams.

Considering first the compact or single block hospital, the system generally installed is that using low-pressure steam throughout the building, exhaust steam being furnished, with a back pressure on the engines and the deficiency in the exhaust steam supplemented by live steam through a reducing valve.

"We have learned by experience," said Mr. Williams, "that for this type of building such a system, if well designed, with means of ample size, so proportioned as to provide a perfect circulation with 1 lb. pressure, and to heat the entire building in the very coldest weather with not more than 5 lbs. pressure, gives good results with a smaller initial cost than any other type of heating system. There is the same fault with this as with every other steam system—namely, that of heat regulation—which is practically impossible except by the addition of a temperature control. This, as it relates to fuel economy, will be considered later.

"Where there is more than one main hospital building, and the buildings are widely separated, the low-pressure steam system is not so well adapted to these conditions if true economy and first cost be considered; for if it is desired to keep the back pressure on the engines within reasonable limits, the heating mains must be very large. On the other hand, if the mains are not properly proportioned for load friction and condensation losses, or if made too small, then the back pressure on the engine is increased, with a consequent reduction in power and increase in steam consumption.

"There are many types of vacuum systems—so many that it is hard even for heating engineers to keep informed—and of these there are but two types which are in general use. One type does nothing but remove the air from the radiators through a system of air pipes, they in turn being connected to a vacuum pump or an injector. Its advantages consist of the removal of air from the radiators, thus increasing their efficiency, the reduction in size of the piping and the reduction of the back pressure on the engines because of the vacuum in the air line system. In a well-designed low-pressure steam plant the addition of such a system is really unnecessary, according to the writer's opinion, especially if the automatic air valves are connected to air lines which are connected together and discharge into a convenient receptacle in the basement, thus doing away with unpleasant odors and discharge of steam and water from leaky air valves. In justice to this system, however, there is no doubt that it works well, gives satisfaction, and could be installed in many heating plants with profit to the institution and comfort to the occupants.

"The other type is that in which vacuum valves are placed on the return or condensation ends of the radiators or coils, the bottom of risers, and wherever it is necessary to drain the supply mains; and these valves are connected to the return mains, which in turn are connected to the vacuum pump. This pump handles all the water of condensation in the system and places a vacuum on the whole, thereby making it especially adapted to large installations where otherwise there would be unduly large mains. This system is of value in the remodelling of old steam heating plants, where, through improper design or growth by piecemeal, the piping is too small, thus necessitating the use of live steam at a high pressure to force a circulation.

Under such conditions it can make a good showing in economy and justifies its use. Large claims for economy are made for this type of system because of the vacuum, but while undoubtedly, in theory, it ought to be more economical than low-pressure steam, in practice leaky vacuum valves often nullify all the advantages claimed for it. This type of system is found to be of great value in large installations where steam is necessary for other uses and where, therefore, the one set of mains can serve all purposes. The last feature has often been the deciding point in favor of wholly steam systems over other types, and has been made much of—entirely too much, in the writer's opinion.

Another system which is in general use in many large hospitals is the hot blast or so-called Plenum system. This consists of a series of fans or blowers forcing heated air through ducts of brick or galvanized iron into the wards and other parts of the buildings, the air being heated by coils placed alongside the blower, or by radiation at the base of the heat flues. This system has many advantages and has been more generally adopted for large institutional work than perhaps any other, though the cost of maintenance is, no doubt, the greatest. The advantages of this system are the concentration of the heating apparatus at one point, the elimination of all steam piping throughout the buildings, and the ventilation or air changes given. The disadvantages are the cost of operation, the power required to drive the fans, and that, if the air is recirculated (as is sometimes done to save expense), it then has no advantages over any direct system, but an additional drawback of the extra cost of operating the fan day and night in very cold weather.

"In nearly all hospital buildings where ventilation is actually required, the method now adopted by the most progressive engineers is to have the ventilation system entirely free from heating—that is, in the rooms and wards is placed sufficient direct radiation to take care of the heat losses through windows and exposed walls and a certain amount of air leakage, the air for ventilation being delivered into the rooms as tempered air at about 70° F. and in such quantity as is required by the number of occupants and the purpose for which the room is used. By this method the temperature of the room can be regulated to any degree desired, and on pleasant days, when windows or doors may be opened, the fan introducing tempered air for ventilation can be stopped and cost of operation saved, while sufficient heat will be maintained by the direct radiation to keep the building comfortable.

STEAM HEATING PIPES UNDER FLOOR

"Another type of heating which has recently been introduced by a large manufacturing concern in New York State is that which inserts lines of steam pipes in the construction under the floors and thus warms the rooms by heating the floors only. This is quite a daring departure from any of the so-called "tested and tried" systems, and the writer does not agree that it could be successfully used in modern hospital practice. It may apply to such buildings as factories, where the occupants are on the floors for only a few hours a day, but I do not think a nurse or attendant could work on such floor the hours required of them in most of our hospitals. The high temperature to which the floors must be heated in order to maintain an even temperature in exposed rooms does not warrant the recommendation of this system for hospital practice, and it will not, therefore, further be discussed.

(To be concluded)

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RECENT tests of vacuum cleaning machinery have served to emphasize again the lack of a standard method for testing such apparatus. The fact that one of these tests was conducted without reference to the amount of horsepower consumed by the vacuum pump, for instance, is a point that is being made much of by those who feel that this is the vital point to be covered. They call attention to the fact that inexperienced architects and engineers throughout the country seem to be at a great variance as to the question of the amount of air they wish to handle per sweeper and the vacuum they will use in cleaning. Among the inexperienced it is customary to call for a one-, two- or three-sweeper plant and let it go at that. Yet this means practically nothing in the way of volume of air and amount of vacuum required for the system, as each manufacturer of vacuum cleaning machinery will figure on a different volume of air per sweeper and a different vacuum to operate on than his competitor. The result is that possibly two systems are offered, each known as a two-sweeper plant, and, as a matter of fact, the actual air displaced by one of the systems will possibly displace 20 cu. ft. of free air per minute while maintaining a vacuum of 5 in., and the other may displace 100 cu. ft. of free air per minute while maintaining 10 in. of vaccum. Thus, although both plants are termed two-sweeper plants, one of them is over five times as large as the other.

A SUGGESTION in this connection, which seems reasonable, is that every architect or owner, in requesting a proposal for furnishing a vacuum cleaning system, should state in the specifications the number of cubic feet of free air to be exhausted per minute for each sweeper while maintaining such vacuum as he deems proper and advisable for the cleaning to be done. When such specifications are made, every bidder submitting a proposal would base his price on performing and meeting certain specified conditions and would guarantee the actual horsepower required to perform such work.

AN ADVANCE in our date of publication, made necessary to comply with the plans of the Postmaster-General to ship monthly periodicals by fast freight instead of by mail, has made it impracticable to publish the monthly weather charts, which we issue during the heating season, in the issue for the succeeding month to that covered by the charts. The October, 1911, weather records, therefore, will appear in the December issue, and so on during the winter.

The Operation of Back Pressure and Atmospheric Relief Valves

Back pressure or atmospheric relief valves, such as are used to protect exhaust steam heating systems, feed water heaters, absorption ice machines, cooking kettles, and other apparatus using exhaust steam against dangerous accumulation of pressure, belong to the general class of safety valves, differing therefrom principally in that they are designed to discharge steam at low pressures. This difference, however, has important consequences as regards the design and proportioning of the valves, since steam escaping from a safety valve at a pressure of 150 lbs. has a velocity of from 2000 to 3000 ft. per second, and as the density under these conditions in the smallest cross-section of the orifice corresponds to a pressure about 60% as great as the initial pressure, a small opening is able to discharge a considerable weight of steam.

On the other hand, steam under a back pressure of 6 lbs. escaping to atmosphere has a velocity of only 1000 ft. per second or so, so that in order to discharge the same weight of steam in a given time the area of the valve opening must be about 30 times as great as in the case of the safety valve. These facts demonstrate at once the futility of the occasional practice of putting ordinary safety valves on feed water heaters and similar apparatus. Due to its small discharge area, a safety valve has hardly any perceptible influence on the rise in back pressure if the exhaust to atmosphere be blocked while the engine is running at full load.

Safety exhaust outlet valves for exhaust steam service are commonly known under two different names—namely, back pressure valves, where the pressure of the steam is normally higher than that of the atmosphere, and atmospheric relief valves, where the pressure underneath the valves is normally much less than atmosphere, as in condenser service, the valve being provided to prevent dangerous rises in pressure, as in case of failure of the circulating water. Back pressure valves proper are usually fitted with means for adjusting the pressure at which they will discharge or "pop," while atmospheric relief valves are usually so arranged that a water seal can be maintained over the valve in order to prevent the infiltration of air between the valve and seat. Many valves, with slight modifications, can be, and are, used indifferently for either service.

The various types of valves on the market can be brought under two general classifications, those having a single plain valve disk, and, second, those having balanced disks. Taking the simple disk as an example, let us study the requirements and mode of action. The back-pressure valve is intended to limit the pressure within the exhaust steam system by opening and allowing the escape of steam as soon as the pressure begins to rise above a predetermined amount. Where the volume of exhaust steam received by the system is only a little greater than that consumed therein, it frequently happens that the valve must open and close at each pulsation of the engine—that is, twice per revolution in the case of a single-cylinder engine. The disk may, therefore, be called upon to rise and fall from 100 to 300 times per minute. In many cases, the disk is held to its seat by weights, so that not only must the valve disk itself lift with this frequency, but the weight as well.

The distance through which the valve disk must move during each oscillation is determined by the amount of exhaust steam to be discharged, since the maximum velocity at which the steam can escape is rigidly determined by the back pressure. If, by opening to its widest extent, the valve is unable to discharge the amount of steam on hand, the pressure within the system will continue to rise until the velocity through the valve is sufficiently accelerated, or until some part gives way, or until the engine is stalled. A little elementary geometry will show that in order to present a free area of opening equal to the area of the circle formed by the valve seat, a valve disk will need to lift through a distance equal to the quarter of the diameter of the valve seat—that is, an 8-in. valve will need to lift 2 in., a 16-in. valve 4 in., a 24-in. valve 6 in., and so on.

As a matter of fact, back-pressure valves, as actually constructed, rarely or never lift as far as this. This may be explained in the following manner: Suppose the valve is set for 10 lbs. back pressure, and has an area of 100 sq. in. Then it will be necessary to put upon the valve a load of 1000 lbs., either by means of a weight, by means of springs or otherwise. As soon as the pressure beneath the valve rises to 10 lbs. per square inch, the valve will lift, and the steam will begin to escape under the edge of the disk. This, however, will be accompanied by a reduction in the pressure of the steam, since it is only by loss of pressure that the steam can gain velocity, so if we conceive a valve to be lifted sufficiently to permit of the escape of a jet of steam at the full velocity due to the pressure, filling the entire circle of the valve disk, we must conceive that the static pressure of the steam beneath the valve is zero.

Under these circumstances, the question naturally arises as to what will sup-

port the 1000 lbs. with which the valve is loaded. The only force available is the impulse of the jet of steam escaping from the valve. If this jet of steam were turned entirely through a right-angle, without losses of any kind, it should be able to support a weight as great as the original load on the valve. In practice, however, the jet of steam is rarely turned through a complete right-angle, and, moreover, the coefficient of discharge of the nozzle formed by the opening in the valve seat is much below unity, so that the valve at best opens only grudgingly, and does not discharge the full quantity of steam that it might be expected to discharge on the basis of the area of the valve opening and the difference in pressure producing the velocity. The result is that all valves of the single-disk type show a marked increase in back pressure if the load rises to anywhere near the supposed capacity of the valves. Also, since the valve never rises to the theoretical limit of one-quarter of its diameter, the area of discharge under the valve is determined by the length of the periphery, rather than by the area of the opening in the valve seat.

The lift of the valve has an important bearing upon another phase of the operation of valves of this kind, and that is, the hammering action upon the seat. The greater the diameter of the valve, the greater the distance through which it must lift to give an area of opening comparable to the opening in the valve seat, but also the greater the lift, the greater will be the velocity and the hammering action when the valve comes back upon the seat again. This must necessarily be the case, since the load upon the valve—that is, the weight of the valve plus the weight or the force of the spring with which it is loaded—is determined by the area of the opening in the valve seat. Moreover, since the area of this opening increases as the square of the diameter, while the periphery increases only directly as the diameter, the intensity of the blow upon the edge of the valve, and upon the valve seat, increases rapidly with the diameter; in fact, we may say that the energy of the blow, since the lift should increase directly with the diameter, and since the load per unit of length on the periphery should increase directly with the diameter, will increase as the square of the diameter, and as the destruction or damage to the valve seat is proportional to the energy expended in the blow, it is obvious that the proper design of back-pressure valves is a very difficult matter.

The more or less theoretical deductions above cited are aptly borne out by practical experience. The disastrous effects of the hammering of the valve seat, especially where it is essential to maintain a nice fit between the valve and its seat, as in high-vacuum work in connection with steam turbines, will be apparent. It is the usual practice to start engines or steam turbines non-condensing—that is, exhausting to atmosphere—and after the engine or turbine is properly warmed and drained and is operating satisfactorily, it is thrown over to the condenser. During the non-condensing period, the atmospheric relief valve is held open by a hand adjustment, leaving a clear passage for the steam to the atmosphere. At the moment of throwing over, however, this adjustment is released, and the valve is temporarily allowed to hammer on its seat, while the main exhaust gate valve between the engine and the condenser is being opened. As soon as the vacuum reaches the atmospheric relief valve it will hold it to its seat, and the operation is completed. The oscillations of the relief valve are more or less efficiently steadied by means of a dash-pot, but with the rubber composition face and brass disk usually employed in atmospheric relief valves, the rubber, being exposed to steam at 212° F., and, in the case of engines, to oil in the exhaust steam, soon fails, and in all condensing plants the most common causes of low vacuum are leaks through the relief valve.

The sluggish action of the large single-disk valve is due to the inertia of the heavy disk and the connected weight, and when the main gate valve to the condenser is opened a great drop in vacuum almost invariably occurs, due to a certain volume of air being drawn into the condenser through the relief valve before the disk of the latter can seat. In the case of a jet condenser, this is extremely objectionable, particularly where the condenser must operate with a high injection lift, and in many cases the throwing over is a difficult and hazardous procedure, since the drop in vacuum at the moment of opening the exhaust gate valve is often sufficient to cause the injection water to be lost, and considerable experience and judgment on the part of the operating engineer are required to adjust the atmospheric relief, the main exhaust gate valve and the injection valve, so that the throwing over may be accomplished with the minimum damage to the relief valve and without losing the injection water. Loss of injection water, it should be remembered, entails starting all over again, priming the condenser, etc., and considerable delay, as the rush of steam into the condenser will have warmed up the latter so that pumping out the condenser by means of the air pump will be a much longer and more tedious operation than before.

In order to diminish the diameter of the valve opening and, therefore, the lift, some makes of valves are fitted with balanced or double-seated disks. This expedient is effective to a certain extent in accomplishing its purpose, since the

mass to be accelerated and brought to rest with each stroke of the valve, and the distance of travel, are both diminished. Certain other difficulties, however, arise. A double-seated valve that will be tight under all conditions of temperature and pressure is difficult and expensive, if not impossible, to make, and since the only force tending to open the valve is the unbalanced steam pressure on the area which one disk possesses in excess of the other, there is more probability of the valve sticking.

Some further mention should be made of the means adopted for holding valves in the closed position. Where weights are used, the amount of back pressure is commonly regulated by shifting the position of the weights on the lever arm, but it frequently happens that more weights are hung upon the arm than was originally intended, or that the arm comes in contact with some obstruction, or is tied down to prevent its free lifting, any of which causes may result in a disastrous explosion; in fact, the use of weighted safety valves in steam boiler practice has been largely discontinued for very similar reasons.

Convenient Means for Determining Flue Gas Temperatures

In the operation of a steam boiler, one of the most important quantities is the temperature of the gases passing to the chimney, since, other things being equivalent, this temperature is a direct measure of the portion of the heat of the fuel which is wasted or not utilized. If we assume 1 lb. of coal having a heating value of 14,000 B. T. U. to be burned with 20 lbs. of air, which is about the smallest ratio of air to coal found in actual commercial practice, the temperature in the furnace after complete combustion should be about 2500° F. above the temperature of the atmosphere. The temperature of steam at 150 lbs. gauge pressure is 366° F., and if it were possible to transfer all of the heat in the gases above this temperature (and it is impossible to transfer any below this temperature) to the steam and water in the boiler, the efficiency of the boiler would be 88%—that is, the boiler would recover all but 12% of the heat of the coal.

As a matter of fact, no boiler reduces the temperature of the gases to the temperature of the steam. There is, therefore, a limit to the amount of boiler surface that it pays to put in. Commercial practice some years ago established this limit of surface at about 10 sq. ft. of boiler surface per boiler horse power, but recent practice has shown that a 1 B. H. P. can be produced from much less surface, as 3 to 5 sq. ft., or even less, and in some plants it has become a matter of routine to drive the boilers at about 60% above the nominal rating of 10 sq. ft. per boiler horse power.

Even disregarding the number of square feet of boiler heating surface employed to produce a boiler horse power, it is found in commercial plants that the chimney gases escape at temperatures considerably above the steam temperature, as at 450° to 500° at least, which

GREEN'S TEMPERATURE PENDANTS FOR DETERMINING STACK TEMPERATURES (EXACT SIZE)

represents a waste of from 20% to 40% of the heat of the coal, depending partly upon the amount of air used to burn a pound of coal.

The usual and most practicable way of recovering waste heat from chimney flue gases is by means of the economizer, the heating surface of which, because of the lower temperature of the contents, is much more active in absorbing heat than an equal amount of surface in the last pass of the boiler. That is, since the economizer receives water at a temperature of 80° to 150° and discharges the water at 200° to 300°, with an average temperature for the whole economizer of around 200° to 220° F., say, it is able to absorb about twice as much heat from 500° F. gases as can the boiler surface.

Indicating and recording thermometers and pyrometers are sometimes put in for measuring the temperature of flue gases, but their use is not general, due partly to their cost and also to the fact that many types of instruments are not reliable or break down in service. There is, therefore, a demand for cheap and

efficient means of determining flue gas temperatures which the Green Fuel Economizer Company, of Matteawan, N. Y., has met by devising the temperature pendants shown herewith. These pendants consist of fusible alloys of the proper composition to indicate the desired temperatures.

It is an interesting fact that the melting points of such metals were found to be too uncertain and evasive to be used as temperature tests. That is, it is difficult to tell the exact point at which the metal melts, since it does not change suddenly from a hard solid to a liquid, as does water, but goes through an intermediate softening stage similar to iron and many other substances. Even after the metal is completely melted, a hard skin of oxide is usually found to have been formed upon its surface, which prevents the metal running easily and, therefore, is apt to confuse the determination of the exact temperature.

The expedient was, therefore, devised of using the tensile strength of the metal, instead of the melting point, as the true indication of temperature. In other words, the pendants are made with a large body, having a certain definite weight, suspended from a narrow neck, and the composition of the metal and cross-section of this neck are adjusted until the body of the pendant will pull the neck in two and fall at some desired temperature.

In actual use the pendants are hung upon a small hook made upon the end of a long wire, which is introduced into the flue so that the pendants will be at the desired point. The best way is to begin with the lowest temperature pendant and proceed until the one is found which will not fall off after 5 or 10 minutes' exposure. The temperature will then lie somewhere between the temperature marked on the last pendant and the next to the last pendant used. In doing this,

TABLE 1.—PERCENTAGE OF HEAT ESCAPING IN CHIMNEY GASES AT VARIOUS FLUE TEMPERATURES, ASSUMING 26 LBS. OF AIR PER POUND OF COAL, AND 14,500 B. T. U. PER POUND OF COAL.

Chimney Temperature Degrees Fah.	B. T. U. in Gases Per Pound of Coal	Percentage of Total Heat in Gases	Ratio of Heat in Flue Gases above 60 deg. to heat absorbed by boiler, assuming 15% Loss through Grates and Radiation, per cent.
200	905	6.25	8.
300	1555	10.7	14.4
400	2200	15.2	21.8
500	2850	19.68	30.2
600	3500	24.1	39.6
700	4150	28.6	50.6
800	4790	33.0	63.4
900	5440	37.5	79.0
1000	6090	42.0	97.5

it is quite essential that several different points in the flue be tried, as it very frequently happens that one part of the flue is occupied by gases much hotter than the gases in other parts of the flue.

At present the Green Fuel Economizer Company has perfected pendants for three temperatures—i. e., 425°, 500° and 550° F.—representing, respectively, the temperature at which the use of the economizer is justified with coal at commercial prices, the temperature at which an economizer is a good investment in all cases, and the temperature at which neglect to install an economizer becomes an inexcusable waste.

For use in connection with these pendants the Green Fuel Economizer Company has calculated three tables which

TABLE 2.—MINIMUM ECONOMIC TEMPERATURE OF GASES LEAVING THE BOILER.

Operating 3100 Hours per Year				Operating 8760 Hours per Year			
Price of Coal Per Ton	Cost of Boiler Horse-Power Year	Critical Temperature Difference Degrees F	Economical Temperature of Gases leaving Boiler. Pressure 150 lbs. gauge Degrees F	Price of Coal Per Ton	Cost of Boiler Horse-Power Year	Critical Temperature Difference Degrees F	Minimum Economical Temperature of Gases Boiler Pressure 150 lbs. gauge Degrees F
$2.00	$14.25	319	685	$2.00	$34.10	133	499
2.50	16.97	268	634	2.50	41.70	109	475
3.00	19.68	231	597	3.00	49.40	92	458
3.50	22.40	202	568	3.50	57.10	80	446
4.00	25.10	181	547	4.00	64.70	70	436
4.50	27.80	163	529	4.50	72.40	63	429
5.00	30.50	149	515	5.00	80.00	57	423

TABLE 3.—MINIMUM ECONOMICAL TEMPERATURE OF FLUE GASES FOR DIFFERENT PRICES OF COAL FOR AN ECONOMIZER PLANT OPERATING 10 HOURS PER DAY AND 310 DAYS PER YEAR.

Price of Coal	Cost of Boiler Horse-Power Year	Critical Temperature Different Degrees F.	Temperature Flue Gases Leaving Economizer for Various Temperatures of Feed Water, degrees F.		
			100°	150°	210°
$2.00	$14.25	112.2	212.2	262.2	322.2
2.50	16.98	94.5	194.5	244.5	304.5
3.00	19.68	81.4	181.4	231.4	291.4
3.50	22.40	71.5	171.5	221.5	281.5
4.00	25.10	63.8	163.8	213.8	273.8
4.50	27.80	57.5	157.5	207.5	267.5
5.00	30.55	52.5	152.5	202.5	262.5
FOR ECONOMIZER OPERATING 24 HOURS PER DAY AND 365 DAYS PER YEAR					
$2.00	$34.10	47.0	147.0	197.0	257.0
2.50	41.75	38.3	138.3	188.3	248.3
3.00	49.40	32.4	132.4	182.4	242.4
3.50	57.10	28.0	128.0	178.0	238.0
4.00	64.70	24.7	124.7	174.7	234.7
4.50	72.40	22.10	122.1	172.1	232.1
5.00	80.00	20.0	120.0	170.0	230.0

NOTE.—The best temperature for the gases leaving the economizer is affected to a certain extent by the conditions in the plant under consideration.

we reproduce herewith. The first shows the percentage of heat escaping in chimney gases at various flue temperatures, assuming 26 lbs. of air per pound of coal, and 14,500 B. T. U. per pound of coal. The second, the minimum temperature to which it pays to cool the gases by means of boiler surface only; and the third, the minimum temperature to which it pays to cool the gases by means of an economizer. These tables are based upon an investment of $15 per nominal boiler horse power in the boiler and $5.00 per nominal boiler horse power in the stoker, grates and draft apparatus, interest at 5%, and sinking fund and maintenance charges at 12%. The figures for the economizer are based on $1.00 per square foot and annual charges for interest depreciation, maintenance power and attendance at 12%, the economizer being notably longer lived and requiring less care and attention than the boiler.

The Green Fuel Economizer Company, we are advised, will be pleased to send samples of these temperature pendants to any one connected with a steam plant who would be interested in determining the temperature of chimney flue gases.

Accident with Gas Stove Due to Ventilating Fan

A singular accident, resulting from the use of an exhaust fan in a room containing a gas stove, is reported from Germany by *Domestic Engineering*. The accident happened in the club room of a restaurant, about 18 ft. square, with a door on one side and two windows on the other. A gas stove about 36 in. wide connected to a flue through 7 ft. of piping, was located on the side near the door, while between the windows an electrically driven 12-in. exhaust fan had been mounted on the wall.

Several of the patrons of the restaurant had retired to the club room after luncheon and, owing to a sudden chilly spell, closed the doors and windows and lighted the gas stove. As the room soon became stuffy with cigar smoke, the ventilating fan was started.

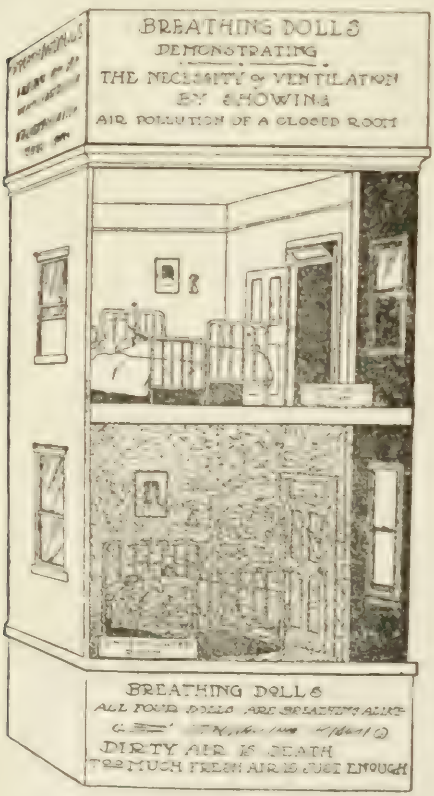
When the door was opened a half hour later by the manager the room was found to be full of escaping gas and the diners asleep. They were hurriedly awakened and the room aired, the guests fortunately suffering no more serious harm than headaches.

An examination brought out the fact that the suction of the fan had drawn the products of combustion from the gas stove out into the room, with the result that the supply of oxygen was reduced until the flames in the gas stove were extinguished. The room then commenced to fill with gas, which might easily have produced serious consequences but for the timely opening of the door.

Breathing Dolls to Demonstrate Good Ventilation

The opinion has often been expressed that if air were colored, with deepening shades for increased degrees of vitiation, an object-lesson would be presented demonstrating to the most confirmed skeptic the valve of pure air. A unique attempt to portray such an object-lesson is being made by Dr. C. St. Clair Drake, of the Chicago Board of Health, using dolls to represent human beings. The "breathing dolls," as they are called, are connected by rubber tubes to a small electric pump, which forces incense through their nostrils. The action of the pump is intermittent to represent breathing.

A demonstration box is used containing two rooms furnished as miniature bedrooms. One side of each of these rooms is of glass, fully exposing the interior to view. Two of the dolls lie abed in each room, one of which has its windows and doors wide open and the other having all openings closed. The pump is then started, supplying equal quantities of incense to the dolls in each room. In the closed room the air soon becomes filled with the incense, so that the dolls can be but dimly seen. In the open room the puffs of incense proceeding from the dolls' nostrils diffuse through the air and pass out, leaving the room almost entirely free of smoke.



DEMONSTRATION CHAMBERS FOR BREATHING DOLLS

The "breathing dolls" in their miniature bedrooms were recently on exhibition at the International Municipal Congress in Chicago, and Dr. Drake has had many calls from child welfare committees and similar organizations in other cities to send on the exhibit for show purposes. Those who have seen the demonstration pronounce it one of the most striking arguments in the cause of good ventilation that has ever been devised.

Current Heating and Ventilating Literature

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

CENTRAL STATIONS

Combination Heating and Generating Plant at Springfield, Ill. El. Wld. Sept. 2, 1911. 8 figs. 4300 w. Describes unique features of flexibility of equipment in station of light, heat and power company. 20c.

HOT-WATER HEATING

Economics of Hot Water. Ira N. Evans. Power. Sept. 12, 1911. 5 figs. 7000 w. Gives some actual results in the form of curves and tables from a plant and also a method of getting at the coal consumption and the cost of exhaust heating applicable to any plant. 20c.

STEAM HEATING

Electricity Supply and Exhaust Steam Heating. Francis H. Savies. El. Rev. Sept. 8, 1911. 5 figs. 4000 w. 40c.

Ozonized Air for London Tubes

One of the strongest objections made to traveling underground in London is the fact that the air is impure and often stifling. What promises to be a revolution in this particular is a plan which has recently been announced by the authorities of the Central London Railway Co., according to which a system of ventilation will be installed capable of pumping daily 80,000,000 cu. ft. of ozonized air into the tube stations and tunnels of that company.

One plant is already in operation and it is hoped that similar ones will soon be completed at every station along the line. It is stated by one of the officials that the plant at each station will pump 400,000 cu. ft. of air per hour into the station, or at the rate of 900 cu. ft. per person per hour.

The air is drawn from outside through a filter screen, which removes dust and dirt and impure gases. A part of the air is then highly ozonized by being passed over highly electrified plates, the proportion of ozone in the whole being one part in 10,000,000. The air is driven by fans to the level of the bottom of the station, and two-thirds of it is distributed over the platform by ducts, with outlets at a height of 7 ft. above the platform. The remainder is driven into the tunnel. The size of the pumping plant is such that it can be installed in a chamber 10 ft. by 8 ft. by 4 ft., and there are 2 miles of duct work.—*From Deputy Consul General Carl R. Loop, London.*

Health Officer of Columbus Urges Better Ventilation

That many public meeting places, stores, factories, moving-picture theaters and street cars of Columbus, Ohio, are in need of better ventilation is the belief of Health Officer J. W. Clemmer, who recently submitted his annual report to the mayor and council of that city.

"The campaign against tuberculosis should be aided by the adoption of regulations requiring ventilation of all places open to the public," says Dr. Clemmer.

One of the chief features of the report is a warning against the use of gas stoves that are not ventilated. Dr. Clemmer declares outlet flues are as necessary on gas stoves and grates as they are on furnaces.

"If upon entering the living room or office from the open air there is detected a stuffy, oppressive atmosphere, suspect slow poisoning of the inmates in the presence of the unventilated stove," says the report. Many a funeral, it is declared, comes from the home heated with unventilated gas or oil stoves.

"The essential function of the blood to carry oxygen from the air to all parts of the body to sustain life is diminished for the reason that there is formed a combination between noxious gas and the hemoglobin of the blood. The oxygen-carrying properties of the blood cells are thus destroyed in proportion to the amount of poisonous air inhaled. The victim of the unventilated gas stove may suffer from a dullworking brain and headache, or death may ensue, depending upon how long and how much he breathes the poisoned air."

Some Essentials of Hospital Heating and Ventilation

In the case of hospital heating and ventilation where the wards are heated entirely by indirect heat the quantity of air supplied should, in any case, be so great that the temperature thereof need not exceed 120° F. at any time.

A general rule for air supply and exhaust is to supply air to all rooms into which patients may enter, and also to the corridors, and to exhaust the vitiated air from all such rooms, and from any other rooms which, because of their special use, would make ventilation desirable.

Humidification has been referred to as one of the essentials of good ventilation. Relative humidity and temperature are most intimately associated. It is true that a temperature of 60° or 65° F. with a relative humidity of 50% or 60% is more comfortable and healthful than a temperature of 70% or 75% with a relative humidity of 20%, the latter condition being frequently observed in our homes, schools and hospitals during the winter.

It is not true, however, that the temperature may be lowered and the humidity raised with a resulting saving in fuel, for it takes vastly more fuel to evaporate into the air the amount of water required to raise the humidity than is saved in the 5%, or even 10%, less to which the air is heated. In determining the capacity of the boiler and in considering the fuel consumption, allowance must be made for humidification.

The subject of direct versus indirect heat for hospitals is much discussed. The direct radiators have the advantage of making possible the quicker and less expensive warming up of the rooms upon the closing of the windows and of giving the patients a place to warm feet or hands at such times, the absence of which in rooms without direct radiators is often criticized by doctors.

The amount of direct radiation used in rooms occupied by patients may well be limited to an amount sufficient to counterbalance the heat losses through wall and glass areas. It should not be used in operating and similar rooms.

Some consideration is being given by the medical fraternity to the subject of artificial cooling of hospital wards. In view of the results of recent investigations as to the effect of excessive temperature and humidity it is reasonable to expect that much good may be accomplished in severe cases by lessening the temperature and humidity within the wards in hot weather. There is little available data, however, as to the clinical value of such an arrangement. A combination of a mechanical refrigerating system with an indirect heating and ventilating system for cooling purposes is quite possible.

Recapitulating, the essential features of a hospital ventilating system may be said to be:

Ample natural or window ventilation.

Supplementary thereto an ample supply of fresh air at a low temperature to all rooms used by patients.

System of exhausting the vitiated air from all such rooms.

Special exhaust fan systems for toilets, baths, slop sink and mop closets, etc.

Separate exhaust fan systems for laundry, kitchen, machinery rooms, etc.

The operating rooms may well be separately treated.

Air intake should be located as high as possible.

All air supplied to the hospital should be freed from dust by means of filters, preferably of the washer type.

Air chambers and ducts should be finished smooth, and so far as possible be subjected to light.

Humidification is desirable, and even essential.

Temperature regulation is desirable and a source of economy.

Direct radiation, of a limited amount, is regarded as desirable.—D. D. Kimball, in *The American Architect.*

Possibilities in the Peat Industry

The great peat deposits of the United States seem destined to remain an undeveloped resource, at least for some time to come, not through any effort at conservation, but because of ignorance of their practical value. According to Charles A. Davis, in an advance chapter on the production of peat from "Mineral Resources of the United States," for 1910, which is issued by the United States Geological Survey, noteworthy progress was made in 1910 in the production of peat fuel in other countries than the United States, not only in the quantity actually marketed, but also in methods of production and utilization. In this country, however, although it is generally known that there are large quantities of material good for fuel in the peat bogs and swamps of the northern and eastern parts of the country, but little progress has been made in developing this resource on a commercial scale.

In commenting on the growing use of peat in Europe, Mr. Davis refers to its value as a gas producer, the resulting "producer gas" having a recognized high value for fuel and power. In a recently perfected gas producer, it has been found that in converting peat containing a good percentage of nitrogen into gas a large amount of ammonia, greatly valued as a fertilizer, can be obtained as a by-product. Mr. Davis quotes from a report which shows that where gas-producer plants using peat are carefully managed, so great are the profits obtainable that it is often possible, while taking no credit whatever for the value of the power gas, to obtain as much as 100% profit from sulphate of ammonia alone, after making proper allowance for the cost of digging the peat, bringing it to the plant, and for labor, stores, capital, shares, etc. Indeed, with peats comparatively poor in nitrogen, it is possible in many cases to produce the gas for nothing, the cost of power being then merely that of operating the gas engines, together with capital charges on the same.

Although these claims may be somewhat optimistic, says Mr. Davis, it is clear that if each ton of theoretically dry peat gasified yields from 75,000 to 90,000 cu. ft. of producer gas, the calorific value of which is from 125 to 135 B. T. U. per cu. ft., and also gives 200 lbs. of sulphate of ammonia as a by-product, the operation of a plant consuming 10 tons of dry peat fuel a day would produce 1 ton of the ammonia salt. The price of sulphate of ammonia has for some years remained very uniform at about $60 per ton, in spite of enormously increased production.

This process, which is of practical application in the United States, Mr. Davis believes, should be investigated carefully by owners of American peat lands, many of which are very rich in nitrogen, some Government analyses showing as high as 3.39% of combined nitrogen. Peat consumption of all kinds in the United States in 1910 amounted to $182,147. The report on the production of peat in 1910 can be obtained by applying to the Director, United States Geological Survey, Washington, D. C.

A New German Book for Heating Engineers

How must a heating plant be designed in order to show the highest efficiency?—In the first place, the amount of boiler heating surface must be correctly determined—namely, just large enough to cover the heat losses of the building. To determine this, it is necessary to know whether the heating is to be intermittent or continuous. While there is no doubt that some buildings (such as office buildings and churches) should be heated intermittently, it is an open question whether intermittent or continuous heating would be more economical for residences and apartment houses. In the former case, boiler heating surface should be larger than in the latter, because of the absorption of heat by walls, when starting the plant, until the transmission reaches the state of permanency. How large, then, should the corresponding heat losses be figured?—In both cases it appears necessary to deal with pipeline losses. How high should these also be estimated?

All heat losses to be covered being known, the amount of boiler heating surface can easily be found by dividing these losses by the rate of heat transmission per square foot per hour. But how high is this rate under ordinary conditions of actual operation, considering unskilled firing by the janitor or by the so-called useful man? Evidently it should vary, first, with the several types of boilers; secondly, whether these boilers are made of cast-iron or steel, and, in fact, it does vary considerably.

With the boiler heating surface correctly determined, the plant designed and installed, how should the firing be done to obtain the best results with the minimum amount of coal consumed?

These questions, as well as a number of others appertaining to heating practice, find the exhaustive answers in the book entitled "Economy of Centralized Heating" (Wirtschaftlichkeit der Zentralkeizung), written in German by G. de Grahl, M.E., who for many years has been consulted as an expert on heating by German courts. The book is, therefore, largely a statement of facts and results obtained in testing a larger number of heating plants under actual working conditions, and brings out many important conclusions, the knowledge of which should prove of great value to everyone interested in heating.

Not everybody knows, for instance, that the rate of heat transmission of boiler heating surface increases with the increasing rate of combustion only up to a certain point, above which it drops in spite of the fact that the rate of combustion may keep on increasing. Nor is everybody aware of the fact that the highest boiler efficiency (in the neighborhood of 80%, and even higher for certain types of boilers) and, consequently, the highest economy, could be obtained and kept fairly constant during the whole heating period, provided, of course, certain conditions are fulfilled as to the manner of firing. One of these conditions, for instance, is a very low chimney draft, something in the neighborhood of ¼-in. water column. The author of the book states that the highest boiler efficiencies usually were obtained by him at this rate of draft. Another interesting statement of the author is that the continuous heating of dwellings is more economical than the intermittent.

The book, which, as stated, is written in German, has only recently appeared and can be had at $1.50 from the publisher, R. Oldenbourg, Berlin and Munich, Germany.

Notes on Heating and Ventilating, Third Edition, by Prof. John R. Allen, professor of mechanical engineering, University of Michigan, has lately been published by Domestic Enginering, Chicago. In view of the addition of much new matter, bringing the total number of reading pages up to 227, the price of the book has been made $2.50, instead of $2.00. The book is essentially a practical work of present-day methods, although the theory of the subject is sufficiently covered. The author has the faculty of expressing himself clearly, and the conclusions he reaches, together with his many useful hints, gain added weight through his acknowledged standing as an authority on the subject. An entire chapter devoted to central station heating shows the increasing interest this subject is arousing on the part of the heating profession. Pp. 227. Size 6 x 9 in. (standard).

Books Received

Transactions for 1910 of the American Institute of Chemical Engineers. Size 6½ x 9½ in. Pp. 407. Published for the institute by D. Van Nostrand Co., New York. Price $6.00, net.

Domestic Sanitation and Plumbing, by A. Herring-Shaw, Associate Royal Sanitary Institute, London, a treatise of the materials, designs and methods used in sanitary engineering manufacture, jointing and fixing of pipes, sanitary fittings, etc.; removal of waste matter; water supply; hot water services; heating, ventilation, etc. Size 6 x 9 in. (standard). In two volumes (Vol. 1, 318 pages), (Vol. 2, 358 pages). Published in America by D. Van Nostrand Co., New York. Price, $5.00, net.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

New York Chapter Formed

A New York Chapter of the American Society of Heating and Ventilating Engineers was organized October 24 at the rooms of the society in the Engineering Societies Building, New York. Twenty-five signed the roll at that time, and the membership list has since been increased to 34. Annual dues were placed at $5.00 for regular members and $3.00 for juniors. Meetings will be held the second Tuesday in each month at the Engineering Societies Building. Permanent organization was effected by the election of the following officers: President, William M. Mackay; vice-president, James A. Donnelly; secretary, Joseph Graham; secretary-treasurer, Arthur Ritter; board of governors, Frank T. Chapman, H. T. Gates and Frank K. Chew.

Nominating Committee Appointed

At a meeting of the Board of Governors of The American Society of Heating and Ventilating Engineers, September 9, the following were appointed a committee on nominations for officers for 1912: S. A. Jellett, Philadelphia, chairman; Homer Addams, New York; N. S. Patterson, Chicago; F. G. McCann, New York; and J. M. Stannard, Chicago.

The dates for the annual meeting of the society have not yet been decided, but it is probable that they will be January 23, 24 and 25, in the Engineering Societies Building, New York.

Meeting of Test Committee

As a result of a meeting of the society's test committee, composed of James A. Donnelly (chairman), William McKiever, M. F. Thomas, Frank T. Chapman and Nelson S. Thompson, it was decided to undertake three forms of tests on radiators to determine their efficiency with the removal of air as accomplished by ordinary methods and with complete air removal, as in special laboratory tests.

Annual Meeting of Illinois Chapter

New officers were elected at the annual meeting of the Illinois Chapter of The American Society of Heating and Ventilating Engineers, which was the first meeting of the fall season. The election followed a dinner at Vogelsang's, October 9. The newly elected officers are: President, S. R. Lewis; vice-president, J. M. Stannard; secretary, W. L. Bronaugh; treasurer, August Kehm; board of governors, N. L. Patterson, E. F. Capron and George M. Getschow. A minute expressing the chapter's loss in the death of the late James Mackay was read and the board of governors was instructed to incorporate the memorial notice in suitable form and forward it to Mr. Mackay's family.

Institution (British) of Heating and Ventilating Engineers

The programme for the autumn meeting of the Institution of Heating and Ventilating Engineers, which was held in London, October 17, included a discussion of the paper read at the summer meeting by E. R. Dolby, on "Some Doubtful Points in Gravity Hot Water Heating" (published by extract in THE HEATING AND VENTILATING MAGAZINE for August, 1911); also on the paper by Oswald Stott, on "Characteristics of the Propeller Fan" (published by extract in THE HEATING AND VENTILATING MAGAZINE for September). Two papers were presented, one on "Centrifugal Fan Testing," by G. L. Copping, and one on "The Effect of Water Pressure in Preventing the Transmission of Heat Through Surfaces," by President O. M. Row.

Two members of the American Society of Heating and Ventilating Engineers were elected members of the Institution, Thomas Morrin, or San Francisco, Cal., and Nelson S. Thompson, of Washington, D. C. Another member of the American Society, C. R. Honiball, of Liverpool, England, was nominated for president of the British Institution.

National District Heating Association

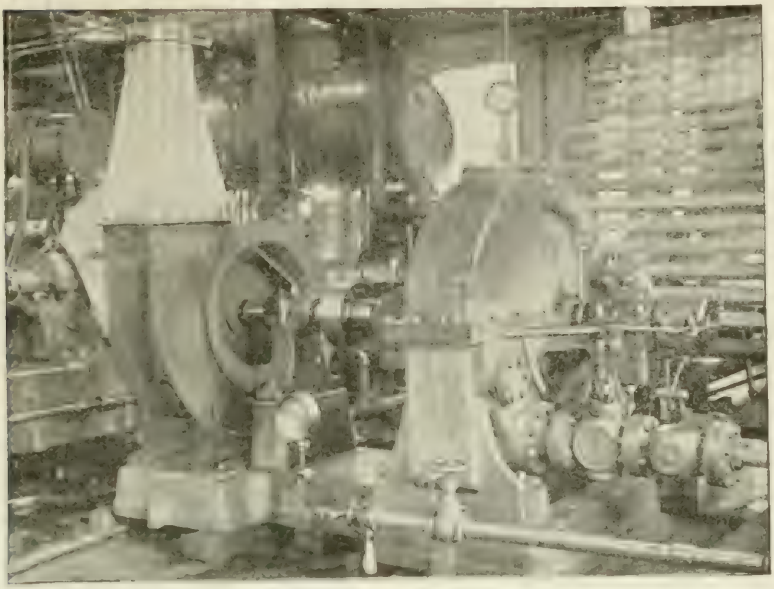
A meeting of the executive committee of the National District Heating Association was called to be held at the Cadillac Hotel, Detroit, Mich., November 8, to fix the time and place for holding the Fourth Annual Convention of the association and to arrange for programme. The committee consists of A. D. Spencer, Detroit, Mich., the president of the association; Warren Partridge, Springfield, Ill., first vice-president; R. D. DeWolf, Rochester, N. Y., second vice-president; Cadwallader Evans, Jr., Pittsburgh, Pa., third vice-president; Geo. W. Wright, Baltimore, Md.; E. J. Keifer, South Bethlehem, Pa.; J. L. Hecht, Chicago, and D. L. Gaskill, Greenville, O., secretary and treasurer.

Test of an Unusually High-Pressure Centrifugal Blower Set

A centrifugal blower delivering air at over 40 in. of water pressure, or nearly 1½ lbs. per square inch, is a new idea to those familiar with centrifugal blowers, which are seldom operated at more than 25 in. of water. At the works of The Terry Steam Turbine Co. a new turbo-blower set was recently tested to see if it would meet the guarantees. The tests of this new design were exhaustive and conducted with great care. This blower set, which consisted of a double-inlet Sturtevant multivane centrifugal blower mounted on the same cast-iron bed with a Terry turbine, and direct-connected by flanged couplings, was to deliver 14,000 cu. ft. of air per minute against a pressure of 40 in. water gauge.

This test was to determine the water rate of the turbine and the closeness of the speed regulation, as well as the volume and pressure of air. During the test, pressure, temperature, and calorimeter measurements were made of the steam just before the governor valve, and the exhaust pressure was measured in the exhaust pipe just beyond the outlet of the turbine. The exhaust steam was taken to a surface condenser and the discharge water from the hot well was weighed. The condenser was vented at the top, so that it would not produce vacuum at the exhaust of the turbine, which was run non-condensing.

To measure the volume of air discharged by the blower, a long tapered cone, having a coefficient of discharge of 0.94, was attached to the outlet, the pressures being taken with a mercury U tube. The blower was to deliver 14,000 cu. ft. of air per minute, but averaged 15,169 cu. ft. for nearly an hour. The steam required for the turbine was not to exceed 7600 lbs. per hour, but during this test steam was used at the rate of 6587 lbs. per hour, or 13.35% less than the guaranteed maximum. The air pressure maintained was to be 40 in. of water, but for nearly an hour this blower averaged 47.3 in., or over 1½ lbs. per square inch. It reached a maximum during a portion of the test of 51.7 in. Consider-



HIGH PRESSURE CENTRIFUGAL BLOWER
SET AS ARRANGED FOR TESTING

Time	Steam Pressure at Throttle, Pounds Gauge	Steam Pressure at Nozzle Inlets, Pounds, Gauge	Total Water Rate Corrected to Saturated Steam	Speed in R.P.M.	Velocity Pressure Reduced to inches Water	Velocity at Cone Outlet, Feet per Minute	Velocity of Air Deliv'y, Cubic Feet per Minute	Horse-Power for Delivering Air, Actual
2:10	140	103		2480				
2:13			6200					
2:15	131	103		2470	47.6	27000	15220	114.1
2:16			6560					
2:19			7000					
2.20	145	105		2480	48.95	27350	15400	118.6
2:22			6840					
2:25	145	105	6800	2480	47.6	27000	15220	114.1
2:28			6780					
2:30	135	102		2440	46.2	26600	15000	109.1
2:31			6525					
2:34			6475					
2:35	150	106		2480	51.7	28100	15850	129.
2:37			7340					
2:40	148	101	6600	2450	46.2	26600	15000	109.1
2:43			6365					
2:45	128	100		2445	46.2	26600	15000	109.1
2:46			6280					
2:49			6520					
2:50	153	102		2450	46.2	26600	15000	109.1
2:52			6530					
2:53	150	101	6610	2460	46.2	26600	15000	109.1
2:58			6310					
3:00	150	100		2460	46.2	26600	15000	109.1
3:01			6240					
Average	145	102.5	6587	2463	47.3	26900	15169	112.6

ing the excess in both volume of air and the pressure at which it was discharged, the blower set delivered 27.5% more work than was called for.

Reducing the guaranteed conditions to steam consumption per horse power for delivering air, gave a result of 58.5 lbs. as against the guarantee of 86.13 lbs. The accompanying table gives more in detail the important readings made during this test.

A separate test to determine the speed gave the following results: The turbine was operated at 2490 R. P. M. without load; with full load thrown on momentarily the speed was 2400 revolutions, and with the full load soon settled to 2460 R. P. M. This shows that the momentary speed drop was 3.6% and the settled drop only 1.2%. While the blower was running under full load at 2460 R. P. M., the gate was closed suddenly; the speed momentarily jumped to 2575 R. P. M., or 4.7%, but it quickly settled to 2490 R. P. M., or an increase of 1.22% over that at full load.

The suitableness of the steam turbine of this type for the direct-connected driving of high pressure blowers was made evident from these results. The high pressure and closeness of speed regulation were made possible by having the governor mounted directly on the turbine shaft. In this way only, it is said, can possible failure of intermediate gear be eliminated. The direct-connected governor, running at turbine speed, was shown by the tests to be very powerful and highly sensitive.

A New Line of Back Pressure and Atmospheric Relief Valves

Apropos of an article on another page of this issue on the operation of back pressure and atmospheric relief valves, a remedy for the various troubles experienced has been found in the use of a multiplicity of disks, instead of one disk. The development of this idea is shown in the accompanying illustrations. Heretofore such a construction has presented insurmountable difficulties to designers of such valves, probably because the means ordinarily employed for holding the disks of back-pressure valves to their seats are not suitable where there are a number of small disks instead of one large disk—that is, it would be difficult to load a large number of separate disks independently by means of weights without greatly complicating the apparatus, and if springs were to be used, means were not available for adjusting the several springs accurately and simultaneously for different back pressures.

The valve shown herewith may be described briefly as consisting of a valve deck upon which are placed a multitude of small valve disks, each individual small disk having a spring to hold it closed, a water cushion or dash pot to arrest its motion and prevent damage to the disk and its seat, and a stem by means of which it may be lifted free of the seat when desired. The tension of the spring is determined by the position of a pressure plate, adjustable by means of a vertical screw, which may be turned one way or the other by means of bevel gears connecting with a horizontal shaft which extends to the exterior of the valve casing, and is fitted with a hand wheel, chain wheel or gear wheel, as circumstances may dictate. The valve deck is placed between the flanges of the bottom and top castings, the latter having two or more hand-hole plates or doors for access to the valve deck.

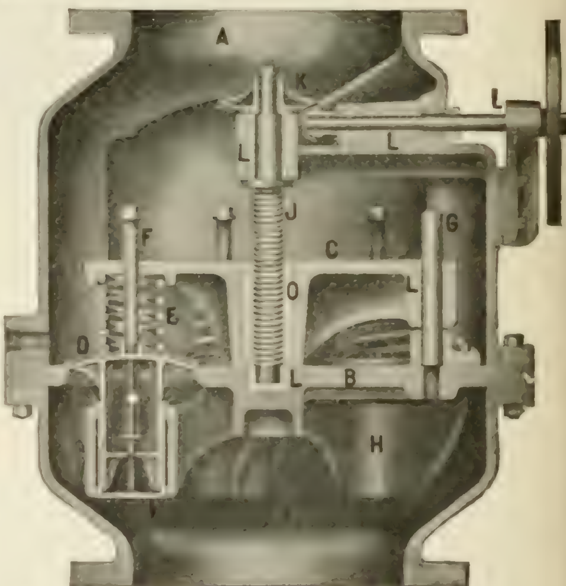


FIG. 1—COCHRANE MULTIPORT SAFETY EXHAUST OUTLET VALVE

A—[illegible]	H—Dash Pot
B—Valve Deck	I—[illegible]
C—[illegible] Plate	J—[illegible] Lowering Pressure Plate
D—Valve	K—[illegible]
E—[illegible]	L—[illegible]
F—[illegible] Stem	O—[illegible] or Bronze
G—[illegible]	

From the type of valve disks used, their large number, and the fact that they are made of bronze, as are also the linings of the dash-pot, it will be seen that the probability of sticking is exceedingly remote. Even, however, in case one disk should be deranged, or for any other reason refuse to leave its seat, all the other disks will continue in operation, so that the possibility of all disks of a valve becoming inoperative at one time is exceedingly remote, in fact almost infinitesimal.

The gain in effective discharge area through the use of the small disks is considerable. As an example, let us take a

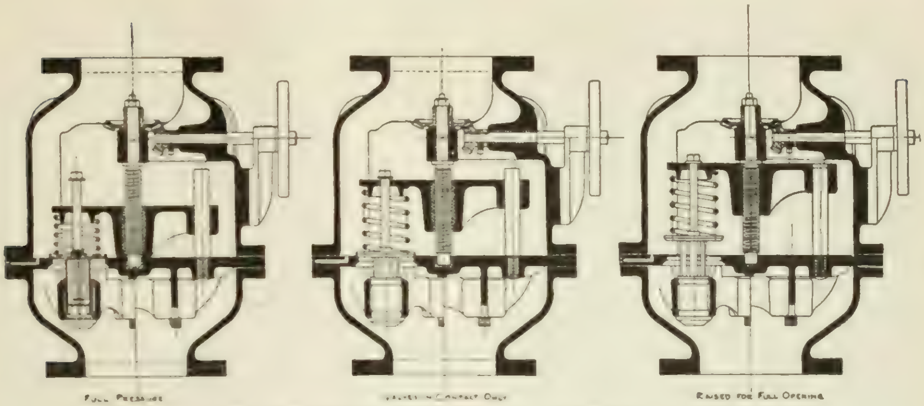


FIG. 2—ARRANGEMENT OF VALVE WITH PRESSURE PLATE SHOWN IN THREE DIFFERENT POSITIONS

10 in. valve. With a single disk, the area of the valve would be 78.7 sq. in., while the periphery of the valve or length of valve seat would be 31.4 in. If the area of this valve were distributed among six small disks, each would have an area under the disk of 13.1 sq. in., and a length of valve seat of 12.8 in., and since there are six disks, the total length of valve seat would be about 77 in., or over twice as much as in the case of the single disk having the same area. It follows from this that the small valve will need to rise less than one-half as far as the large valve in order to discharge the same amount of steam with the same back pressure. As a matter of fact, in the valves here shown the aggregate area of the small disks is somewhat larger than the areas of the circle corresponding to the size of the valve, in order to provide an unrestricted passage for the steam when the disks are raised for exhausting free to atmosphere.

As the individual disks are small and light, and have only a small lift as compared with a large disk, and are held to their seats by springs instead of weights, the total mass in motion when the valve disk closes is comparatively small, so that the small disks are not only quick to respond, but strike their seat with much less force per lineal inch than does the large disk held down by a weight. The seating of the disks is retarded by cushions of water in the dash-pots beneath the disks. It is found that there is always water in these dash-pots, due to the condensation of the steam, but where dash-pots are inverted, as in some types of valves, they will contain only steam or air, which is not as effective in arresting the motion of the plunger as is water.

An important advantage of this design of valve is found in the means for adjusting the tension of the springs. This may be done by raising or lowering the pressure plate. At the same time, it is impossible for a certain pressure to be exceeded without substituting new springs—that is, when the pressure plate is down all the way, the springs are compressed to the maximum extent.

The illustrations show both the ordinary back-pressure valves, intended for exhaust steam heating, drying and similar service, and valves for vacuum service. The latter differ chiefly in the use of lighter springs, and in provision made for water sealing. The water seal may be of the simple overflow type,

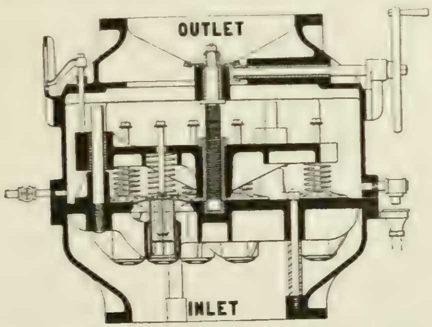


FIG. 3—ARRANGEMENT OF VALVE FOR VACUUM SERVICE, SHOWING OVERFLOW TYPE OF WATER SEAL

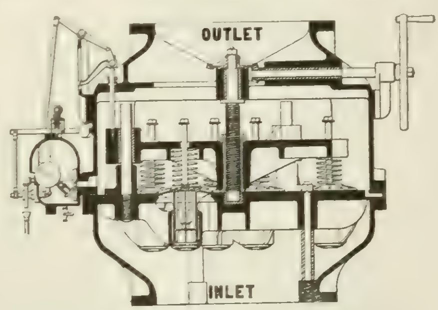


FIG. 4—ARRANGEMENT OF VALVE FOR VACUUM SERVICE, SHOWING TRAP-CONTROLLED WATER SEAL

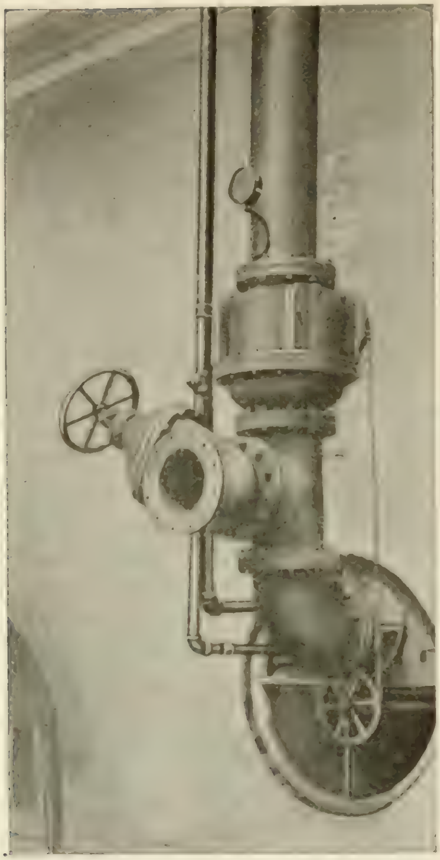


FIG. [illegible]—TYPICAL INSTALLATION OF COCHRANE MULTIPORT SAFETY EXHAUST OUTLET VALVE.

shown in Fig. 5, the water entering through the valved connection at the left, and overflowing at the right; or it may be of the trap-controlled type, shown in Fig. 6, which is more economical of water, since, when the water reaches the required depth on the plate, the further admission of water is cut off by the float in the float chamber. In order to prevent waste of water when the valves are raised for exhausting free to atmosphere, a system of levers is provided which closes a valve in the supply pipe. As shown in Figs. 5 and 6, an indicator is provided on the outside showing when the disks are fully raised or closed.

The three drawings in Figs. 2, 3 and 4 illustrate the several positions of the pressure plate and valve disks when the valve is set to the maximum back pressure, when set with the valve disks just touching the seat, as when only a few ounces of back pressure are required to force steam into heaters or other apparatus, and finally with the valves raised to the maximum height to allow free exhaust to atmosphere.

The type of valve herewith described and illustrated is known as the Cochrane Multiport Safety Exhaust Outlet Valve, and is manufactured by the Harrison Safety Boiler Works, 3189 North 17th street, Philadelphia, Pa., to whom we are indebted for the information and illustrations used. This company also controls patents fully protecting the several novel features involved.

The Rennert Automatic Electric Regulating Devices

Automatic electric appliances for regulating boiler feed, for controlling ventilators, pumps, etc., and for maintaining even temperatures in hot-water tanks, are among the interesting devices that have recently been perfected by Otto Rennert & Co., Munich, Germany. In addition to the uses stated, the company's appliances are designed to control boiler dampers, mixing valves for baths, etc., gas burners, and reducing valves.

Typical uses of the Rennert devices are shown in the accompanying illustrations. Fig. 1 shows the arrangement for regulating the temperature in a hot-water tank. The valve for plants with high pressure is operated by an electric-driven motor. Where low-pressure steam is used, the valve is operated by magnetic

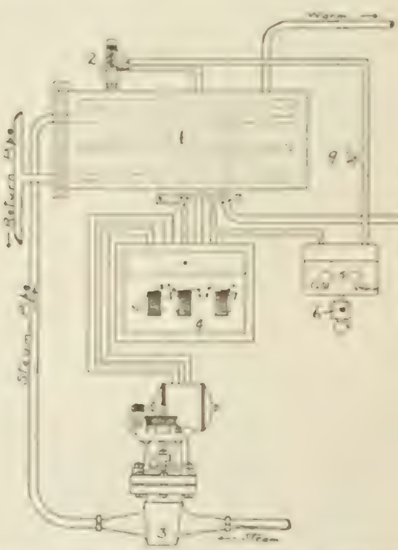


FIG. 1—ARRANGEMENT OF AUTOMATIC ELECTRIC TEMPERATURE REGULATING APPARATUS FOR WATER TANKS

1—Water Tank
2—Thermometer
3—Steam Supply Valve
4—Switch Board, with Relays Operating Steam Valve
5—Indicator Board
6—Alarm Bell
7—Connection for Open Circuit
8—Connection for Closed Current
9—Open Circuit Connection to Operate Indicator Board

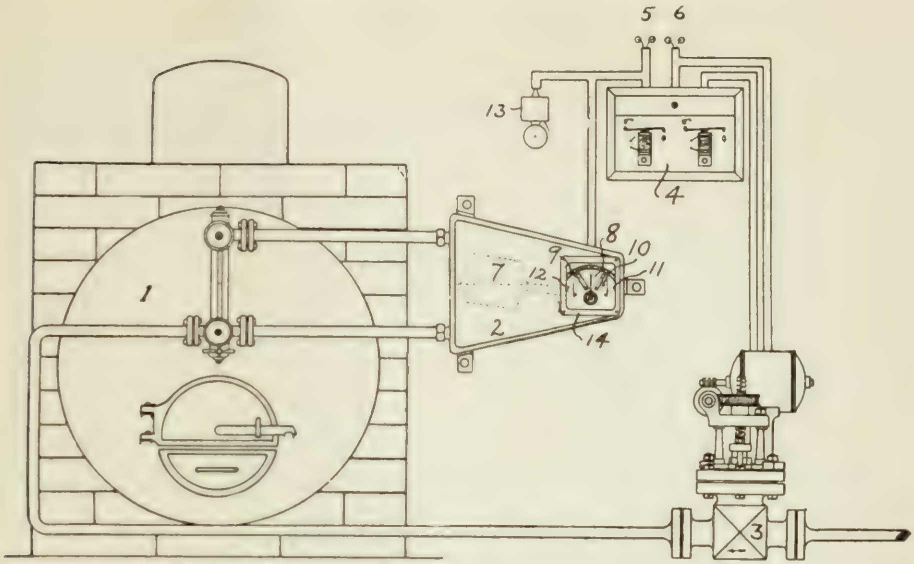


FIG. 1—ARRANGEMENT OF AUTOMATIC ELECTRIC BOILER FEEDER

1—Boiler
2—Water Gauge Controlling Device
3—Boiler Feed Valve
4—Relay Box
5—Connection for Closed Circuit
6—Connection for Open Circuit
7—Water Float
8—Rotary Axis Hand
9-10—Adjustable Contacts
11-12—Safety Contacts
13—Alarm Signal
14—Glass Case

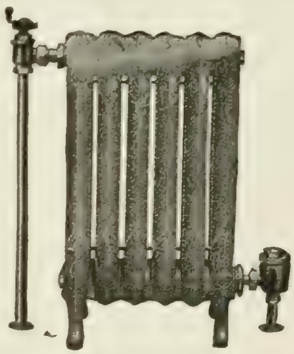
levers. In either case, the general arrangement is the same. The hot-water tank is shown at (1). The hot-water thermometer (with its platinum contacts) is shown at (2). The steam supply valve (3) is attached to an electric-driven motor. The switch-board with its relays, by means of which the steam valve is opened and closed, is shown at (4). These relays are operated through the closed circuit wire (8). The motor for the steam valve is operated through the wire (7). The indicator board is shown at (5) operated through the open circuit wire (9). The indicator board has an electric alarm bell (6) which rings in case of trouble.

Fig. 2 is an automatic electric boiler feeder. The float (7) indicates the water level in the boiler. This float operates the dial (8), which may move either way. When the water level goes down, the dial makes contact at (9), and when the higher water level is reached the dial makes contact at (10). When contact is made at (9), through its connection in the relay box, the feed valve is automatically opened. On the other hand, the feed valve closes when the dial makes contact at (10). The alarm signal (13) is used to safeguard the plant against any unusual disturbance.

These, as well as the company's devices, are the subject of an interesting catalogue recently published by the manufacturers.

Steam Distribution in Radiators with the Modulation System

There has always been a great deal of doubt as to the nature of the steam distribution in radiators equipped with a fractional valve on the supply and an automatic water and air relief valve on



RADIATOR 3HOWING SPACE OCCUPIED BY STEAM WHEN VALVE INDICATOR IS AT FIRST OPENING

the discharge. Recent tests made by Warren Webster & Co., Camden, N. J., show that when the features of the Modulation system are used there is a well-defined portion of the radiator supplied with steam while the rest is cool.

In the Modulation system, on the supply end is a modulation valve capable of

being opened in proportion to the amount of heat needed for a comfortable temperature, the index dial showing the degree of opening. On the return end is placed an automatic water and air relief valve which, as its name implies, automatically relieves the radiator of condensed steam and air, but prevents the escape of steam.

As the automatic discharge valve is connected with a return open to the atmosphere, it appears that when the supply of steam is reduced the air backs up into the radiator, and, being heavier than the steam, occupies the lower portion of the radiator, reducing the temperature below that of the upper part.

Advertisers' Index

* Every other month

TRADE AND MISCELLANEOUS NOTES

Coming Events

Second Tuesday in Each Month.—Meeting of the New York Chapter, American Society of Heating and Ventilating Engineers, Engineering Societies Building, 29 West 39th street, New York.

December 5-8, 1911.—Annual meeting of the American Society of Mechanical Engineers, New York. Headquarters at the Engineering Societies Building.

January 23-25, 1912.—Probable date of Annual Meeting of American Society of Heating and Ventilating Engineers. Headquarters at the Engineering Societies Building.

Miscellaneous Notes

Des Moines, Ia.—The Des Moines Central Heating & Power Co., organized in 1891, and granted a franchise by the city during that year to lay mains in the streets of Des Moines, will rebuild its plant, lay new mains and again open for business, according to a communication filed by W. H. Schott, president of the new company, with the city clerk. The territory bounded on the east by the Des Moines river, on the west by Tenth street, on the north by Chestnut street and on the south by Market street, will be served. Oronda H. Davison, vice-president of the Standard Life Insurance Company, is understood to be one of the principal stockholders in the new enterprise.

Peoria, Ill.—Suit has been brought by Albert G. Sherer, of Chicago, against F. Meyer, Brother & Co., Peoria, Ill., manufacturers of heating apparatus, on the ground that certain parts of the company's heating apparatus and the fittings thereof were claimed to be patented when in reality they were not covered by patents. The penalty for the violation of the statute covering this point is $100 for each offense. There are 4117 counts in the present charge, filling 3000 sheets of typewritten manuscript. Conviction on all counts would mean a total fine of $41,170, of which the plaintiff would get one-half.

Louisville, Ky.—An ordinance has been introduced before the general council of the city at the instance of the Kentucky Electric Company, under which a franchise for the manufacture and sale of steam heat in the central districts of the city is provided for. The proposed ordinance states, among other things, that the smoke emitted from the stacks in the congested districts is a menace to health, as well as the cause of much dirt, and suggests a central plant for the manufacture of steam as a means of doing away with these conditions. The streets that would be covered by the heating system are Third, from Washington to Market; Fourth, from Main to Walnut; Fifth, from Main to Jefferson; Center, from Jefferson to Green; Washington, from First to Third; Main, from Third to Seventh; Market, from Fourth to Fifth; Jefferson, from Second to Fourth and from Fifth to Sixth; Green, from Third to Fourth; and Walnut, from Third to Fifth. The plant is expected to cost $450,000. Where steam heat is sold on a flat rate, the rate is to be 35c. per square foot. The meter rates are to run from 90c per 1000 lbs. for amounts under 5000 lbs. per month for each 100 sq. ft. of required radiation, to 45c. for amounts over 5000 lbs. per month.

Anderson, Ind.—The city council has granted a steam heating plant franchise

for a period of 25 years to Otis P. Crim, of Indianapolis. The Anderson Trust Company, in control of the plant of the defunct Home Heating Company, had applied for the franchise, and it was agreed to grant it to the Anderson Trust Company until the trust company was advised by the auditor of the State that a trust company could not accept a public franchise. The trust company proposed, however, to assign the franchise to Mr. Crim, who has bought the plant of the Home Heating Company, which went into receivership some time ago, and arranged to operate the same beginning in October, and promises to rebuild the plant next year. Mr. Crim's company will charge by meter rate at 65c for the first 100,000 lbs. condensation, the prices ranging downward from that point to 45c for 300,000 lbs. or more.

Baltimore, Md.—Judge John C. Rose, in the United States Circuit Court, rendered a decision October 13 in favor of the Government in its dissolution suit against the Standard Sanitary Mfg. Co. and others forming the so-called "bath-tub trust." Judge Pritchard concurred in the decision, while Judge Goff dissented. This case is separate from the criminal action against the alleged trust being tried in Detroit against the same defendants.

Plumbing and Heating Magazine is the title of a new trade journal published by a number of Philadelphia jobbers of heating and plumbing supplies. The new periodical, it is stated, is not intended to compete with any of the established trade journals, being intended to foster the interests of the jobbers in the territory covered by the journal, and to bring about a better understanding between jobbers, manufacturers and plumbers. The journal is issued bv the Commerce Publishing Co., 505 Arch street, Philadelphia, and its editorial committee consists of J. Harvey Borton, of Haines, Jones & Cadbury Co.; E. S. Thompson, of the Haynes-Thompson Co.; Walter Walls, of Walls, Owen & Stambach Co. The publication committee consists of F. W. Dows, of the Keystone Supply & Mfg. Co.; F. H. Shuster, of the Shuster Plumbing Supply Co.; and John F. Fleck, of Fleck Bros. Co. The advertising committee consists of John G. Fleck; William Froelich, of Froelich Bros; and C. J. Rainear, of C. J. Rainear & Co.

Eastern Supply Association, at its quarterly meeting, in New York, October 11, elected the following officers for the ensuing year: President, P. M. Beecher, Pierce, Butler & Pierce Mfg. Co., Syracuse, N. Y.; first vice-president, John A. Murray, John A. Murray & Co., New York; second vice-president, F. H. Locke, Locke, Stevens & Co., Boston; secretary, Frank S. Hanley, New York; treasurer, Martin Behrer, Behrer & Co., New York. An interesting talk on "Credits" was given by Daniel L. Hansom, of Petersham, Mass.

Arthur D. Little, Boston, chemist and engineer, has been elected director in the Standard Alcohol Co., New York. This concern has been organized with a capital stock of $12,500,000 to manufacture ethyl alcohol from waste wood

Manufacturers' Notes

Crane Valve Co., Bridgeport, Conn., is building a new pattern storage building. The construction will be of brick, with steel trusses and cement tile roof. The building will occupy a site 353 ft. by 50 ft., and will be one story high, with the trusses of sufficient strength to carry monorail travelers for handling heavy patterns. The building was designed by the Hopper-Falkenau Engineering Co., New York.

Spencer Heater Co., Scranton, Pa., is building a one-story addition to its plant. The new building will be 40 ft. by 87 ft., of brick and wood construction.

American District Steam Co. announces the removal of its general offices from Lockport, N. Y., to its new works at North Tonawanda, N. Y. The company is sending out a handsomely engraved notice of the change, together with a cordial invitation to the trade to visit its new plant at North Tonawanda.

Ilg Electric Ventilating Co., Chicago, Ill., has established a New York branch at 13 Park Row, in charge of George Breidert, an experienced expert on fan work. The branch office will carry a full line of the company's fans and blowers and will be equipped to make prompt deliveries.

Garden City Fan Co., Chicago, Ill., has made arrangements with the L. J. Wing Mfg. Co., 90 West street, New York, to act as its eastern representatives. The company has also opened an office in Birmingham, Ala., in the Woodward Building.

Carrier Air Conditioning Co. of America, Buffalo, N. Y., reports that the boards of education throughout the country are gradually realizing the possibilities of obtaining pure air for school children by mechanical means. Some of the more recent installations of the Carrier air washing apparatus made by the company are School No. 20, Rochester, N. Y.; the Fairbanks, Rose and Bennett Schools, Detroit, Mich.; Girls' High School, Louisville, Ky.; Lewis and Clarke High School, Spokane, Wash.; Northwest Grammar School, Philadelphia, Pa., and the Ohio Mechanics' Institute, Cincinnati, O. Canada is not far behind in these installations, and the same company reports the following installations, embracing territory from coast to coast: Brooklyn School, Winnipeg, Man.; two school buildings in Saskatoon, Saskatchewan; George Jay School, Victoria, B. C.; Student Union Building, and the Engineering Building, McGill University, Montreal, and five public schools in Montreal.

Trade Literature

Capitol Automatic Expansion Tanks, made by the United States Radiator Corporation, Detroit, Mich., are called to the attention of the trade in new circular matter, emphasizing among their advantages that they always keep the system full of water, require no attention on the part of the owner, are sightly in appearance, prevent freezing in exposed locations, and require neither gauge glass nor altitude gauge. The tanks are made of hardwood, lined with copper and furnished with cast-brass trimmings.

Graphite, for October, 1911, the monthly publication issued by the Joseph Dixon Crucible Co., Jersey City, N. J., contains, among other things, a page of photographs of the company's Boston sales force, H. A. Nealley, manager. One of the salesmen in the Boston office, A. K. Ingraham, holds the unique position of being one of the oldest salesmen in the country. An interesting article on "Purity of Graphite" takes up the matter of the carbon percentage of Dixon's various grades of graphite. To the question, "What is the difference between graphite and carbon?" the only answer, it states, seems to be that "graphite is soft and unctuous, while carbon is hard and has no unctuous feeling." The article goes on to explain why it is difficult to make a satisfactory reply as to the carbon percentages of graphite.

Radiation for September, 1911, published by the United States Radiator Corporation, Detroit, Mich., continues the interesting serials which began in the August issue on "Heating Buildings with Steam," by Roufis St. John, the present installment taking up continuous steam and return mains, divided circuit mains and down-feed or drop-riser systems; also "The Story of the Match," by George E. Walsh, and "Fuel and Draft," by James J. Cosgrove, continuing his discussion of the classification of coals. Other notable articles in this issue are "The Eskimos of the South," by Charles Wellington Furlong; "Some Recent Installations in Lyons, France; and "How Coke Is Made," by [illegible] Farrington.

J-M Packing Expert for September, 1911, the interesting house organ of the Cleveland, Ohio, office of the H. W. Johns-Manville Co., is made a special fall covering number and is enlarged to include descriptions of the company's line of coverings for the factory, the home, and for other uses. The illustrations show a battery of heaters and pipes properly covered with J-M asbestocel blocks and cement for the heater and J-M asbestocel sectional covering for the pipes; also the municipal garbage reduction

plant in Columbus, O., and the boiler and engine rooms of Corrigan, McKinney & Company's furnace in Cleveland, O.

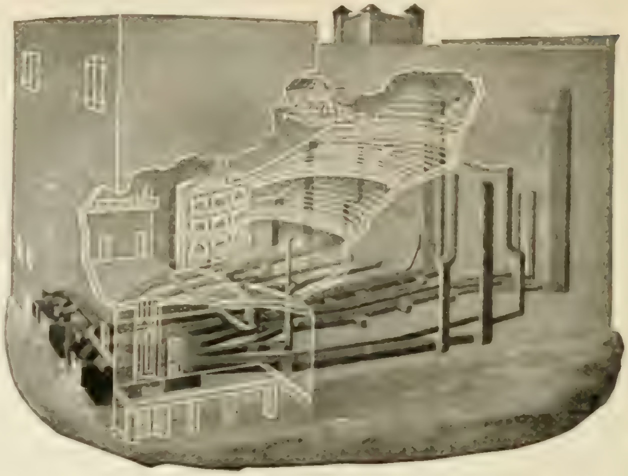
J-M Roofing Salesman for October, published by the H. W. Johns-Manville Co., New York, contains an illustrated description of "A Twentieth Century Garage," of A. F. Holden, in Cleveland, O. The garage was built on the ruins of one destroyed by fire, and the views presented of the carriage room show the walls and ceiling covered with J-M asbestos wood, ¼ in. thick, and 3-in. wide J-M asbestos wood batten strips over all joints. All windows and door casings are made of 1-in. thick J-M asbestos wood.

Powers System of Temperature Regulation is the subject of a handsome new catalogue published by the Powers Regulator Co., Chicago, Ill. In addition to an exhaustive description of the Powers devices, with new and well-executed plates, the catalogue contains typical layouts of indirect heating systems, properly equipped with the Powers system, showing each installation in detail. An additional layout shows a heating layout with humidity control, equipped with the Powers hygrostat. Twenty pages are taken up with views of more important buildings containing installations of the Powers temperature regulation system. Pp. 40. Size 7 x 10 in.

American Rotary Valve Company's line of vacuum and compressed air machinery for cleaning, sweeping, scrubbing and disinfecting, is described in a new catalogue issued by the company, whose headquarters are at 56-58 Dearborn street, Chicago, with a New York office in the Metropolitan Building. The company is at present installing the vacuum cleaning plant for the new post-office building at the Pennsylvania Railroad Terminal in New York, and the catalogue shows types of the steam-driven vacuum machines used in this installation, as well as many detail views of this and other types. The company has many important installations to its credit in the west, as illustrated by typical views of buildings it has equipped. Pp. 32. Size 6 x 9 in. (standard).

Hot Blast Heating and Ventilating Outfits are exhaustively discussed in a 94-page book bearing the title "Heating and Ventilating," in which the Green Fuel Economizer Co., Matteawan, N. Y., has brought together the information required for the designing and proportioning of hot-blast outfits for heating, ventilating, drying, etc. The book contains some two or three dozen tables of temperatures required in rooms for various purposes; heat transmission through building materials; heat given off by occupants and by lights; standard sizes

of hot-blast heaters; frictional resistance of air washers; relative humidities; humidities and temperatures throughout the United States; amounts of air required for ventilation; equivalent air pressures, velocities and horse powers; total weight of air at various barometers and temperatures; pressure and power consumed in friction; speed, capacity and power of steel plate fans; friction of air through hot-blast coils, etc. The text takes up not only the usual details relating to the construction of fans, heaters and heating ventilating systems, but also the calculation and designing of piping systems, giving for the latter two methods differing somewhat—viz., that used in the office of the Supervising Architect at Washington, and that proposed by Rietschel and covering the resistance of sheet-iron pipes and of angles, bends, branches, grills or registers, etc. There is also a chapter on the loss of head of air flowing through orifices and equivalent orifices, in which is presented a method of combining the resistances of ducts in parallel and series connections analagous to the Ohm's and Kirchoff's laws for electrical circuits. Another chapter gives the result of an extensive series of tests upon Green's Positiv-flo steam heating coils, by means of which



GREEN SYSTEM OF HEATING AND VENTILATION FOR THEATRE, WITH INDEPENDENT SYSTEM FOR STAGE

heaters of suitable sizes may be selected for any given duty. The general illustrations of the book include not only views of buildings equipped with heating and ventilating apparatus built by the Green Fuel Economizer Co., but also detailed plans, elevations and "ghost" views showing the actual arrangement of the fans, heaters, piping, outlets, etc. Copies of this book will be sent upon requests to architects, heating and ventilating engineers and others concerned with the purchase, design or operation of heating plants.

For Sale

For sale, patent rights for the Wizard Valve Fitting, illustrated and described in the October issue of this journal. It is one of the most valuable inventio:.s ever devised for one-pipe steam heating systems. For further particulars, address J. J. Wilson, consulting engineer, 917 North 66th street, Philadelphia, Pa.

Business Troubles

Neiman Mfg. Co., New York, manufacturers of hot water heating apparatus, has had two executions filed against it in favor of Jay L. Adams, Jr., for $7378, and Simeon F. Sullivan, for $431. The company is a Delaware corporation, organized in 1910. President, Jay L. Adams; treasurer, Simeon F. Sullivan.

Canton Foundry & Heating Co., Canton, O., has failed with liabilities at $11,582 and assets at $130,754. An item of $80,000, listed in the assets, is given as the value of the patents owned by the concern.

New Firms and Business Changes

Arthur M. Alvord, 25 West 42nd street, New York, has opened a contracting office for steam and hot water heating.

Merchants' Heat and Light Co., Chicago, has increased its capital stock from $500,000, all common, to $3,000,000, of which $1,000,000 is common and $2,000,000 preferred. Of the new stock, $500,000 will be issued at this time.

Hays Plumbing Co., Morristown, N. J., is the new title of the business heretofore conducted by Tompkins & Welsh, of that place. The business was purchased by Joseph A. and William B. Hays.

D. M. Quay has opened an office in the Williamson Building, Cleveland, O., as consulting and contracting engineer for the mechanical equipment of buildings.

Wilson Pipe Covering Co., Grand Rapids, Mich., manufacturer of coverings for underground piping, has increased its capital stock from $5,000 to $30,000.

Hayes Bros., Indianapolis, Ind., heating and ventilating contracting engineers, are building a new two-story building at 26-28 West Vermont avenue, which they will occupy when completed. The new building is 150 ft. deep.

J. D. Hull, 621 Colman Building, Seattle, Wash., has opened an office in that city as a contracting engineer for heating and ventilating plants.

New Incorporations

Western Blower Co., Seattle, Wash., capital $15,000. Principal stockholders: J. K. and A. O. Miller.

Steam Specialties Supply Co., Seattle, Wash., capital $20,000. Principal stockholders: A. Boyd, W. L. Collier and F. Carver.

Moseley Plumbing & Heating Co., Wilmington, Del., notice of whose incorporation with a capital stock of $25,000 was announced in our last issue, was incorporated by F. O. Moseley, E. Demarest and C. Romagna, all of Wilmington.

Taylor Heat & Light Co., Columbianna, O., capital $30,000. Incorporators: W. A. Chambers and others.

Advance Water Heater Co., Chicago, capital $10,000, to manufacture water heaters. Incorporators: P. A. Thompson, C. T. Temple and W. H. Gilbert.

Hubbard Caloric Pump & Mfg. Co., West Toledo, O., capital $25,000, to manufacture and sell pumps and other machinery. Incorporators: F. B. Hubbard, B. B. Brim, William B. Duck, F. M. Landis and A. Schaefer.

William J. Wright Corporation, Salt Lake City, Utah, capital $10,000, to conduct a heating and plumbing business. President, William J. Wright; vice-president, secretary and treasurer, I. B. Wright; additional director, Frederick H. Wright.

John Richman Plumbing Contracting Co., Bronx, New York, capital $10,000, to engage in heating and plumbing. Incorporators: John Richman, Joseph Lipkoff and Isidor Richman.

Burke Valve Co., Cleveland, O., capital $50,000. Incorporators: W. B. Burke, W. G. Rose, T. H. Duncan, W. H. West and Fred C. Backus.

H. G. Smith Co., New York, capital $12,000, to conduct a heating and ventilating contracting business. Incorporators: Howard G. Smith, 128 Fort Green place, Brooklyn; Alfred A. Driggs, Mountain View, N. J., and Richard I. Phillips.

E. S. Bradley Co., Manchester, Mass., capital $20,000, to take over the heating and plumbing business of Edward S. Bradley, of that place. President and treasurer, E. S. Bradley; secretary, W. H. Allen.

Contracts Awarded

U. S. Plumbing & Heating Co., Ontario, Ore., heating, ventilating and plumbing Holy Rosary Hospital, at that place, for $6,326.

Prox & Burget Co., Terre Haute, Ind., heating and plumbing college and conservatory of music buildings for the Sisters of Providence, at St. Mary's, Ind. The work will cost $35,000.

McGinness-Smith Co., Pittsburgh, Pa., steam heating and ventilating Mt. Washington School, in that city, for $8,000; also heating New Castle High School, for $4,800.

American Warming and Ventilating Co., Pittsburgh, Pa., heating and ventilating school building at Washington, Pa.; also heating and ventilating new $50,000 high school at Freedom.

Chafer Co., Cleveland, O., heating new Statler Hotel in that city. The plumbing contract went to Dewstoe & Brainerd, of Cleveland.

M. D. Holmes & Son, Worcester, Mass., heating new Meade Street Schoolhouse, for $7,926; or without automatic temperature regulation, $7,076. Other bids were: J. W. Callahan & Co., $8,513, $7,696; O. S. Kendall & Son, $8,428, $7,592; Edwin Hawes Co., $8,375, $7,497; A. Burlingame Co., $8,250, $7,372; N. J. Smith, $8,175, $7,365.

Shields & Liedley, Lansing, Mich., heating and plumbing the E. W. Sparrow Hospital Building, at that place, for $20,000; also heating and plumbing new building for the Michigan School for the Blind and remodeling its power plant and underground piping system, for $13,000.

Oakes Heating & Plumbing Co., Evans City, Pa., heating, plumbing and lighting.

Olean Plumbing & Lighting Co., Olean, N. Y., remodeling steam heating system in buildings of the St. Bonaventure College and Seminary at Allegany, N. Y., for $12,000.

Barlow Bros. Co., Waterbury, Conn., heating and plumbing new building for St. Mary's Hospital at that place.

Buffalo Forge Co., Buffalo, N. Y., forced draft equipment for the Bethlehem Steel Co., necessary to take care of the increased size of its Saucon plant. The contract calls for a 200-in. standard Buffalo steel plate fan, direct-connected to a 10 by 20 in. horizontal side-crank Buffalo steam engine. About six years ago, when this plant was built, six similar Buffalo outfits were installed by this company; also heating and ventilating apparatus for the new stave and heading mill and tub factory of Armour & Co., at Hill City, Minn., including 120-in. Buffalo steel plate exhauster, direct-connected to a 7 by 7 in. Buffalo vertical engine, Buffalo heaters and system of air ducts for the stave and heading mill, and a 100-in. exhauster, driven by a 6 by 6 in. direct-connected Buffalo engine, for the tub mill.

H. B. Smith Co., Providence, R. I., heating and ventilating new Riverside and Rumford grammar schools at that went to Samuel Jackson & Sons, Pawplace, for $5,803; the plumbing contract went to Samuel Jackson & Sons, Pawtucket, at $3,104.

Badger Engineering Co., Milwaukee, Wis., hot air heating system for the paper mill of the Grandfather Falls Co.

F. S. Spencer, Minneapolis, Minn., heating and ventilating new Barnum High School, at Duluth.

McGuire Bros., Rockford, Ill., heating and ventilating P. R. Walker School at Rockford, for $10,387. The company also has the plumbing contract.

William H. Conklin Co., Columbus, O., heating and plumbing State serum farm at Reynoldsburg, for $5,932.

Barbour Heating and Electric Co., Birmingham, Ala., heating Ensley High School at that place, for $12,495.

Ruhaak & Lackman, Pekin, Ill., heating, ventilating and plumbing for the county farm buildings, for $7,800.

Fred Swinth, Chehalis, Wash., heating new hospital building for the State Training School at Chehalis, for $2,193.

Piper Bros., Trenton, N. J., heating and plumbing new school building at the State Home for Boys at Jamesburg, for $4,000.

Lewis & Kitchen, Kansas City, Mo., heating Greene County Court House at Springfield. A steam hot blast system is being installed.

Midgeley Bros. Co., Salt Lake City, Utah, heating plant for new county hospital buildings at that place.

Clark & Jones, Lima, O., heating and ventilating school building at Canton, O.

Modern Heating Co., St. Louis, Mo., heating addition to police headquarters in St. Louis, for $4,419.

Hub Plumbing & Heating Co., Newburyport, Mass., heating and ventilating Curtis school buildings.

John G. Sutton & Co., San Francisco, Cal., boilers and boiler auxiliaries for the City and County Hospital Buildings, for $49,800; also heating Bankers' Investment Building at that place, for $4,969; the plumbing contract for the latter job went to William S. Snook & Son, at their bid of $12,050.

Robert Dalziel, Jr., Co., San Francisco, Cal., heating new building of the Knights of Columbus, Golden Gate avenue and Leavenworth street, for $9,000.

Business Chances

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following-named work:

Until December 5, 1911, for the construction complete of the buildings for the United States Quarantine Station at San Juan, P. R., consisting of five one-story buildings, having a total ground area of 14,260 sq. ft., with reinforced concrete walls and floors, and tile and tin roof covering.

BOOKS ON HEATING AND VENTILATION

Heating and Ventilating Buildings, a standard manual for heating engineers and architects. By Prof. R. C. Carpenter. Fifth edition, largely rewritten. 577 pages. 277 Ills., 8vo. cloth. $4.00

Baldwin on Heating; or Steam Heating for Buildings. By William J. Baldwin. Fifteenth edition. Revised and enlarged. 391 pages. 131 figures. Size, 5x7½ in. Contains descriptions of steam heating apparatus for warming and ventilating large buildings and private houses, with remarks and tables. Cloth, $2.50.

Handbook for Heating and Ventilating Engineers. By Prof. James D. Hoffman and Benjamin F. Raber. The latest book on this subject. Unusually comprehensive. 320 pages, with 45-page appendix. Size 4½x6¾ in., bound in flexible leather. Price. $3.50.

Questions and Answers on the Practice and Theory of Steam and Hot-Water Heating. By R. M. Starbuck. Illustrated. $1.00.

Ventilation of Buildings. By William G. Snow and Thomas Nolan. 83 pages. Pocket size. Contains a statement of the general principles of ventilation and of their application to different kinds of buildings. Boards, 50c.

Steam Heating and Ventilation. By Wm. S. Monroe. Containing formulas and data valuable in the designing of heating and ventilating plants. Price, $2.00.

Air-Conditioning. By G. B. Wilson. Being a short treatise on the humidification, ventilation, cooling and the hygiene of textile factories—especially with relation to those in the U. S. A. With figures. 12mo. Illustrated. 143 pages. Price, $1.20.

Steam-Electric Power Plants. By Frank Koester. A practical treatise on the design of Central Light and Power Stations and their economical construction and operation. 473 pages. 340 ills. Price, $5.00.

Light, Heat and Power in Buildings. By Alton D Adams, M. E. The purpose of this volume is to present in compact form the main facts on which selection of the sources of light, heat and power in buildings should be based. The problem is to determine the kind of equipment that will yield the service required at the least cost. 12mo. Cloth, $1.00.

Practical Steam and Hot Water Heating. By Alfred G. King. Containing over 300 detailed illustrations. The book is a working manual for heating contractors, journeymen steam fitters, architects and builders. Describes various systems of heating and ventilation and includes useful data and tables for estimating, installing and testing such systems. 8vo. 367 pages. Price, $3.00.

Dean's System of Greenhouse Heating, by steam or hot water, with formulas for obtaining different temperatures, by Mark Dean. Price, $2.00.

Power, Heating and Ventilation. By Charles L. Hubbard, B.S., M.E. A treatise for designing and constructing engineers and architects. The whole subject of heating is covered, including the heating of large institutions with central plants. Space is also devoted to electrical matters connected with steam plants. 647 pages. Price, $5.00 (three volumes in one).

Notes on Heating and Ventilation. By John R. Allen. 150 Pages. 44 Illustrations. Size, 4½x 6½ in. One of the new books, brought quite up to date, and containing much information to guide the intelligent steam fitter in the installation and heating and ventilating apparatus. Cloth, $2.50.

Hot-Water Heating and Fitting. By W. J. Baldwin Fourth edition. Price, $4.00

Steam Fitters' Computation and Price Book, abridged. By Mark Dean. Price, $2.50

Practical Treatise Upon Steam Heating. By F. Dye. Embracing methods and appliances for warming buildings, etc. Low pressure, high pressure and exhaust steam. 8vo, cloth, illustrated. Price, $4.00.

The School House. Its Heating and Ventilation. By J. A. Moore. 204 pages, illustrated. $2.00.

A Manual of Heating and Ventilation, for engineers and architects, embracing tables and formulas for dimensions of pipes for steam and hot-water boilers, flues, etc. By F. Schumann. Second edition, revised and enlarged. 12mo, $1.50.

German Formulas and Tables for Heating and Ventilating Work, especially adapted for those who plan or erect heating apparatus. By Prof. J. H. Kinealy. Illustrated. Price, $1.00.

Tables for Calculating Sizes of Steam Pipes. By Isaac Chaimovitsch. A manual for the determination of steam pipe sizes for low pressure heating. 48 pages. 4 insert tables. Price, $2.00.

Centrifugal Fans. By J. H. Kinealy. A theoretical and practical treatise on fans for moving air in large quantities at comparatively low pressures. 206 pages. 39 diagrams. Full limp leather pocketbook round corners, gilt edges. Price, $5.00.

The Principles of Heating. By William G. Snow. A practical and comprehensive treatise on Applied Theory in Heating. 161 pages. 42 illustrations. 38 tables. Size, 6x9 in. Cloth, $2.00.

Modern Sanitary Plumbing, Steam and Hot Water. By James J. Lawler. 400 pages. 228 illustrations. Size, 6x9 in. This is the latest edition of Mr. Lawler's well-known work on this subject Price, $5.00.

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Organic Matter in the Expired Breath

RECENT EXPERIMENTS SHOWING THAT RESPIRED AIR CONTAINS MANY SUBSTANCES, NOT YET DISCERNIBLE, SOME OF WHICH MAY HAVE AN IMPORTANT BEARING UPON HEALTH

By MILTON J. ROSENAU AND HAROLD L. AMOSS

The efforts being made by the medical fraternity to solve the question of the real cause of the ill-effects of vitiated air are well illustrated in an exhaustive series of experiments conducted by Milton J. Rosenau and Harold L. Amoss, of the Department of Preventive Medicine and Hygiene, Harvard University, which are reported in detail in the *Journal of Medical Research* for September, 1911. A description of the tests and the principal results obtained are given herewith:

The presence of organic matter in the expired breath has long been suspected but never demonstrated. These substances have eluded chemical tests; and animal experimentation has heretofore furnished contradictory and inconclusive evidence. The writers here present results which they believe demonstrate that the expired breath contains organic matter and that this organic matter is specific in nature.

In the early experiments of Claude Bernard (1857) animals were confined in atmospheric air and in mixtures both richer and poorer in oxygen than atmospheric air. He explained the poisonous effects of carbonic acid when respired to be due to the fact that it deprived the animal of oxygen. Similar results were reported by Valentin and by Paul Bert. Richardson, in 1860-61, found that a temperature much higher or lower than 20° C. had the effect of shortening very considerably the lives of animals confined in an unventilated jar. Pettenkoffer shortly thereafter (1860-63) believed that the symptoms observed in crowded ill-ventilated places were not produced by the excess of carbonic acid nor by a decrease in the proportion of oxygen in the air. He further did not believe that the impure air of dwellings was directly capable of originating specific diseases or that it was really a poison in the ordinary sense of the term, but that it diminished the resistance on the part of those continually breathing such air.

The animals exposed to Brown-Séquard to the expired breath of other animals died and he believed they died as a result of poisonous matters in the expired breath. Whether these poisons were of organic nature or not could only be surmised; in fact, their very presence was vigorously denied by Billings, Mitchell, Bergey, and others who repeated Brown-Séquard's

experiments with contradictory results.

The ill-effects from breathing air contaminated with the expired breath is now generally assumed to be due to the increased temperature and moisture rather than to the poisons which have so long been suspected and sometimes taken for granted. Thus Benedict has kept persons in his calorimeter breathing and re-breathing the same air with a CO_2 content as high as 2% for 24 hours without discomfort, the only precaution being to keep the temperature down and to remove the moisture. It is to be noted that in these experiments some of the air was passed over lime and sulphuric acid every two hours, and the greater part of the moisture was removed by condensation, which may also remove other substances than the carbonic acid and moisture.

EXPIRED BREATH STERILE WITH QUIET RESPIRATION

One of the notable achievements of bacteriology was to show that the expired breath during normal quiet respiration is practically sterile. The moist mucous membranes of the upper respiratory passages act as a bacterial trap. Before this demonstration it was assumed, and commonly believed, that many of the communicable diseases were transmitted from person to person through specific poisons contained in the expired breath. The fact that the expired breath usually contains no bacteria robbed it of much of the horror with which it had long been regarded. When science demonstrated that the expired breath was not particularly dangerous, so far as the specific viruses of the communicable diseases are concerned, it was entirely acquitted and given a free bill of health in the minds of many sanitarians. Flügge's demonstration of droplet infection and its possibilities partly restored the expired breath to a position of possible danger.

Our changing views towards the dangers in the air are well illustrated by the attitude of the surgeon. At first Lister and his followers in antiseptic surgery attempted to sterilize the air coming in contact with the wound. The work of Pasteur, Tyndall and others had fostered the belief that the air was full of dangerous bacteria. The surgeon now largely disregards the air of a well-appointed surgical clinic. He, however, ties pieces of sterile gauze about his mouth and nose and over his hair to prevent contamination by these sources.

Since it has been shown that the air under ordinary circumstances is not usually the vehicle by which the communicable disease and the infections are conveyed, the pendulum has swung to the other extreme, especially as no harmful substances of a chemical nature could be demonstrated in the expired breath. The common experience that a vitiated atmosphere is harmful has recently been explained by its increase in temperature and increase in humidity. Some sanitarians have gone so far as to state that if the temperature and moisture can be kept down and the air kept in motion, say, by an electric fan, it may be re-

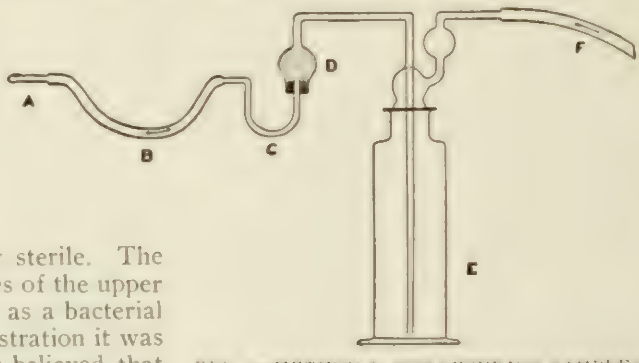

FIG. 1—METHOD A FOR SECURING SAMPLES OF EXPIRED AIR

A. Mouth-piece.
B. Rubber connection.
C. Trap.
D. Filter of glass wool.
E. Drexel bottle which stands in an ice and salt freezing mixture.
F. Rubber connection to vacuum pump.

breathed. To this view the writers cannot subscribe, for they have always felt that a vitiated air must contain substances which are harmful even though not demonstrable to science.

EXPERIMENTS ON MICE TO SHOW PRESENCE OF ORGANIC MATTER IN VITIATED AIR

In 1863 Hammond demonstrated the presence of organic matter in vitiated air by experiments upon mice and also by passing the air vitiated by respiration thraugh potassium permanganate. He confined a mouse under a large jar in which the carbon dioxide was taken up by baryta water as fast as it was formed and the moisture absorbed with calcium chloride. Nevertheless the mouse died in forty minutes. The observation was repeated a number of times and death ensued invariably in less than one hour. Brown-Séquard and D'Arsonval condensed the moisture in the exhaled breath, and the liquid thus collected was injected into the veins of rabbits. Death usually took place in a few days; sometimes in a few weeks. They believed from this that

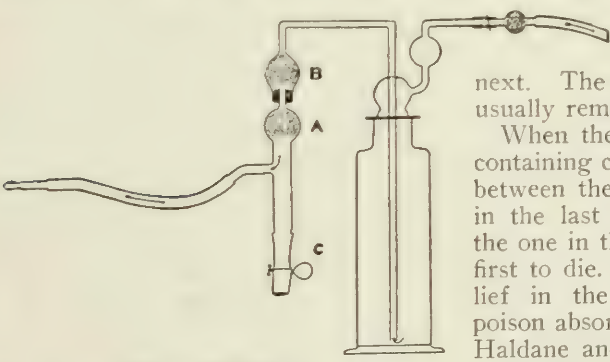

FIG. 3—METHOD C

The apparatus in this method contained two glass-wool filters, A and B, and an improved trap controlled with a Mohr's pinchcock. The bulbs A and B were surrounded with a box warmed with a 16-candle power electric globe and the temperature controlled by a thermometer between 37° and 40° C.

they had discovered a volatile organic poison of the nature of an alkaloid similar to Brieger's ptomaines.

These experiments were repeated with variable results, but in 1889 they reported ingenious experiments in which they obtained additional evidence in support of their former statements. Rabbits were confined in a series of jars connected with rubber

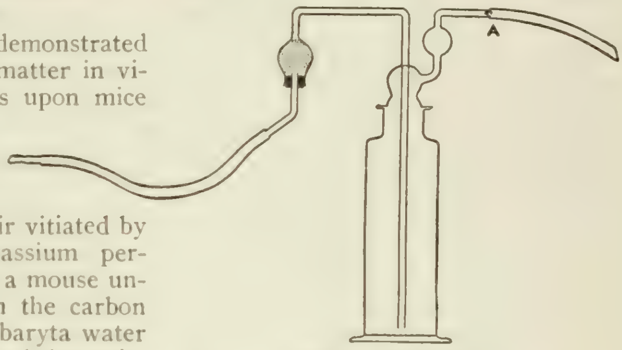

FIG. 2—METHOD B

Similar in all respects to Method A, excepting the form of trap, and an additional cotton filter at A, to prevent contamination from the outlet of the Drexel bottle. As a further guard against contamination, the neck of the Drexel bottle in this and all subsequent methods was swathed with several layers of sterile gauze.

tubing permitting a constant current of air to be passed. The animal in the last jar received the air from the lungs of the animals in the other jars. This animal died after an interval of some hours and the animal in the next died next. The first and second animals usually remained alive.

When they placed absorption tubes containing concentrated sulphuric acid between the last two jars the animal in the last jar remained alive while the one in the jar just before was the first to die. This confirmed their belief in the existence of a volatile poison absorbed by the sulphuric acid. Haldane and Smith repeated the experiments of Brown-Séquard and D'Arsonval, using five bottled mice. They continued the exposure for 53 hours without ill-effects to the mice. Beu, in 1893, also repeated these experiments and came to the conclusion that acute poisoning through the organic matters contained in the expired air was not possible and that the death of the animals was due to changes

of temperature and accumulation of moisture in the jars. Bauer, in 1893, also Lübberd and Peters, concluded from similar experiments that there are no organic poisons in the expired air.

INOCULATION OF ANIMALS WITH CONDENSED FLUID FROM HUMAN BREATH

Lehmann and Jessen, in 1890, collected from 15 to 20 cu. cen. of condensed fluid per hour from the breath of a person exhaling through a glass spiral laid in ice. This fluid was always clear, odorless, neutral in reaction and contained slight traces of ammonia from persons with good teeth; more from those with poor teeth. Inoculation of this condensed fluid into animals gave negative results. In 1894, Brown-Séquard and Davis reported further experiments in which they inoculated over 100 animals with the condensed fluid of respiration and not only confirmed their former statements, but were unable to understand the failure of other experiments, and emphatically reaffirmed that the breath contains a volatile poison and that the death of animals under experimental conditions is not due to an excess of carbon dioxide nor a deficiency of oxygen. This question was studied by Billings, Mitchell and Bergey in 1895, who came to the conclusion that the ill-effects of a vitiated atmosphere depend almost entirely upon increased temperature and moisture, and not to an excess of carbon dioxide or bacteria or dust of any kind.

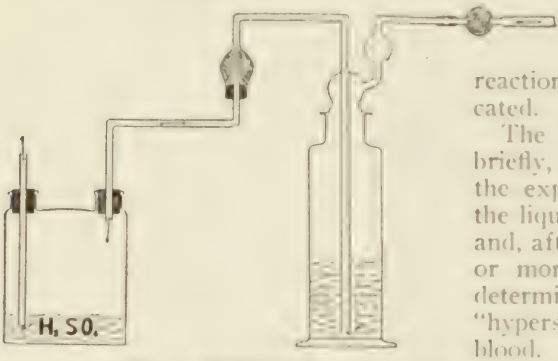

FIG. 4—METHOD D

Apparatus Used in the Experiments with Milk

The air was first passed through a Woulf's bottle containing concentrated sulphuric acid, then filtered through glass-wool and bubbled through the milk in the first Drexel bottle and the vapors thus collected were condensed in a second Drexel bottle not shown in the diagram.

ARRANGEMENT OF PRESENT TESTS

It will be seen from this brief review that this question of the presence of organic matter in the expired breath is in confusion.

The present experiments were taken up in order to demonstrate, if possible, the presence of organic matter in the expired breath by means of the reaction of anaphylaxis. It is now generally recognized that the reaction of anaphylaxis is exceedingly delicate, for by its means we are enabled to distinguish so small a quantity as 1/1,000,000 cu. cen. of blood serum or 1/20,000,000 of a gram of purified egg-white—amounts far too small to detect by any chemical method. The reaction of anaphylaxis has the further advantage of being specific, so that if organic matters are found through this reaction their nature may be predicated.

The method adopted consisted, briefly, in condensing the vapors from the expired breath of man, injecting the liquid so obtained into guinea-pigs and, after an interval of several weeks or more, testing the guinea-pigs to determine whether they have become "hypersusceptible" to normal human blood.

The fact that the guinea-pigs showed a definite response clearly indicates that they were sensitized with a protein substance of human origin. This statement is based upon the fact now well established, that guinea-pigs may be sensitized only with albuminous matter higher in structure than peptones, and the specific nature of the phenomenon makes it reasonably certain that the protein matter in this case must have been of human origin.

At first sight it seems almost incredible to believe that such a complex molecule as protein may be volatile.

Nevertheless, such appears to be the natural conclusion to draw from the results of our experiments. After all, the question of volatility may have much similarity to the question of solubility. Theoretically, all substances are soluble, although some in minute amounts; in the same sense all substances may be volatile. Volatility does not mean necessarily a change to the gaseous state in the sense that simple substances are volatile. Thus we may assume that solid and liquid substances may pass into the air in a state of "colloidal suspension." The simplest conception would be to regard the protein as passing off in solution in the watery vapor. Whatever the physico-chemical conception, the inference is forced upon us that protein may pass into the air in the expired breath and be again collected in sufficient amounts to produce a definite biological reaction in susceptible animals.

The fact that organic substances, specific in nature, have been definitely demonstrated in the expired breath does not prove that these substances are poisonous. The physiological effect of such organic matter must now be studied.

SUMMARY AND DISCUSSION

Through the reaction of anaphylaxis the presence of organic matter has been demonstrated in the expired breath.

Ninety-nine guinea-pigs were tested in 25 different experiments. Of the 99 guinea-pigs 26 gave definite symptoms of anaphylaxis; this does not include the animals showing suggestive or mild symptoms. In four of the animals the reaction was so severe that death ensued from anaphylactic shock.

The expired breath of eight persons was tested; of these five gave positive reactions; upon each of the remaining three only one experiment was made.

This organic matter must, according to the interpretations of our knowledge of anaphylaxis in the guinea-pig, be protein in nature.

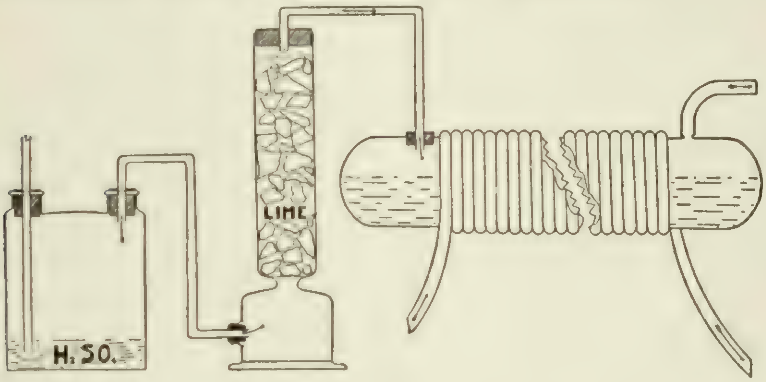

FIG. 5—METHOD E

METHOD USED IN THE EXPERIMENTS WITH EGG AND BLOOD

The air was first dried, being passed through concentrated sulphuric acid in a Woulf's bottle and then through a tower containing lime. The dried air was conducted over the surface of the eggs or the blood in a horizontal glass tube 3 inches in diameter and 3 feet long, thence to a Drexel bottle (not shown in the diagram) standing in a freezing mixture, where the moisture was condensed. The horizontal tube was surrounded with a coil of rubber tubing through which was circulating warm water at 37° C.

Further, this protein substance is specific and for the present it is assumed to come from the blood.

The indications are that this organic matter is probably present in variable amounts, although the reaction is a qualitative and not a quantitative test.

The fact that a number of the experiments resulted negatively may mean either that the organic matter is present in the expired air in exceedingly small amounts or that the guinea-pigs with which we worked did not come from a very sensitive race. There are indications which suggest that the expired breath from certain

persons contains more organic matter than from other persons; also that the amount varies with conditions. The writers obtained a greater percentage of reactions in the guinea-pigs injected with the liquid condensed from the expired breath of females than those injected with the liquid condensed from the expired breath of males. Whether this is a mere coincidence or not may be determined only by collecting more extensive data.

A few experiments were recorded to determine the effect of time, temperature, acids and alkalies upon the organic matter in the expired breath, but the data are too limited to draw conclusions. It is of practical importance to collect further information along these lines. It would also be interesting to study the organic matter in the expired breath in health and disease; in different ages, etc.

SALIVA CONTROL.

One possible source of error was kept in mind throughout these experiments, that is, that particles of saliva might pass the barrier of the cotton wool and appear in the condensed liquid. If guinea-pigs can be sensitized with saliva the least fault in technic in this regard would render the results misleading. Every precaution was taken to prevent this accident. The bulbs were tightly stuffed with glass wool and the fact that bacteria did not get through is a fair indication that other particulate matter did not pass.

It becomes important to know whether guinea-pigs sensitized with saliva will respond after a proper interval to a second injection of human blood serum.

In some of the experiments the guinea-pigs were given a first injection of an amount of saliva far in excess of any quantity that could possibly have been contained in the liquid condensed from the expired breath under the conditions of our experiments. At the second injection they were given normal human serum in the same amounts and by precisely the same methods used to demonstrate the presence of organic matter in the expired breath.

The guinea-pigs injected with human saliva gave practically no response to a second injection of human blood serum.

A comparatively large number of the guinea-pigs inoculated subcutaneously with the condensed liquid from the expired breath developed sloughs at the site of the injection. It is not certain whether this was due to the presence of the relatively large amounts of liquid injected or to some irritating principle contained in the liquid. Occasionally the local effects may have been due to the fact that the liquid was cold when injected. The injection of the condensed liquid caused no other untoward symptoms upon the animals, which is quite contrary to the observation upon rabbits of Brown-Séquard and others.

The best results were obtained when the second injection was given directly into the heart. With a little practice this operation upon the guinea-pigs is easily performed and unattended with any ill-effects.

The logical conclusion from the results of these tests is that protein substances under certain circumstances may be volatile. It seems unlikely that such a complex molecule should possess the power of passing into the air in a gaseous form. The volatility, however, now in question may resemble that solubility which deals with particles in suspension in a physicochemical state (colloidal suspension). The protein may simply be carried over in "solution" in the watery vapor.

The experiments are too few to state that albuminous substances such as egg-white, milk, or blood serum in vitro is "volatile." However, they are sufficiently suggestive to stimulate further work along this line.

ORGANIC MATTER NOT NECESSARILY POISONOUS

The fact that organic matter is present in the expired breath does not mean that these substances are poisonous. The physiological effects should now be studied. It is evident, however, that the air contains many substances which we cannot at present discern, some of which may have an

important bearing upon health. Thus it is well known that most of the cases of sudden death following the first injection of horse serum (diphtheria antitoxin) occur in adults. Children rarely give a severe immediate reaction at the first injection. How the adults become sensitized has always been a mystery. It may now be assumed that some susceptible persons may absorb, through the lungs, enough horse protein, from close association with horses, to become sensitized. This hypothesis will be tested by exposing guinea-pigs to the expired breath of horses and then testing their power of reaction to horse serum. The expired breath of other animals will be similarly tested and the condensed breath of animals other than man will also be studied.

The fact that the expired breath contains definite amounts of specific organic substances will also have an immediate bearing upon the problems of ventilation and the effects of vitiated air. There has recently been a growing tendency to regard the ill-effects of vitiated air as due to the increased temperature and moisture, but it is now apparent that there are other factors which must be taken into account.

Review of Heating Literature

EDITOR'S NOTE.—*This is the second of a series of articles reproduced from former issues of* THE HEATING AND VENTILATING MAGAZINE. *These articles are here presented in response to a steady demand for the back numbers which contained them, but which were long since out of print. The first article, in the November issue, was entitled, "Greenhouse Heating Charts," by John A. Payne.*

II—CROSS SECTIONS OF CHIMNEYS

BY C. C. MULFORD

From the many widely varying rules for finding the cross-section of a chimney per height of same when horse power is given, it is difficult to fix upon any one, as "one man's food seems to be another's poison." Therefore, I give the following rule and table, based upon my practical experience as the one I have found to fill all wants. Assuming that every reader knows that the difference between the temperature of the gases in the chimney and that of the outside or surrounding air is the cause by which draft is effected, it will not be necessary to use up space and time by going into it to any great extent.

As air expands 0.002 of its volume for every degree it is raised above 32° F., the chimney must be made to conform to the demands for space. This can be done in two ways: first, by increasing the cross-section area; second, by increasing the height, which gives greater velocity and thus takes care of the increased volume, the latter being the more practical one.

The economical flue for a dwelling house should have a velocity not to exceed from 5 to 7 ft. per second. This may be had in flues or chimneys, say, from 38 to 40 ft. high by an increase of temperature from 10° to 12° above the outside air.

Tredgold's rule for chimneys for steam boilers is as follows: "The area of a chimney in inches for a low pressure steam engine, when above 10 H. P., should be 112 times the horse power of the engine, divided by the square root of the height of the chimney in feet.

"*Example:* Required area of a chimney for an engine of 40 H. P. its height being 70 ft. In this case

$$\frac{40 \times 112}{\sqrt{70}} = 533.2 \text{ sq. in.''}$$

In another place Mr. Tredgold advises that chimneys be built double the size called for by this rule. In that event the chimney would contain 1066.4 sq. in. or about 7½ sq ft.

Horse-power	Height of Chimney, in Feet																																
	38	44	50	56	60	65	70	75	80	85	90	95	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
1	64	64	64	....	....																												
2	64	64	64	64	..																												
3	64	64	64	64	64																												
4	64	64	64	64	64	64	....																										
5	72	66	64	64	64	64	64																										
6	84	79	74	70	68	65	63	60																									
7	101	92	87	82	79	76	73	71	68																								
8	115	107	99	94	90	87	84	82	79	77																							
9	130	118	111	108	101	97	94	90	87	86	83	81																					
10	144	131	123	117	112	108	104	100	97	96	92	89	87	83	79	76																	
12	173	157	148	140	134	130	125	121	117	115	110	107	104	99	94	91	88	86															
14	220	186	173	163	157	151	146	142	136	134	129	125	121	116	110	105	102	101	97														
16	230	210	197	187	180	173	167	161	155	154	147	143	138	131	124	121	118	113	[illegible]														
18	247	236	226	210	202	195	187	181	178	176	166	160	151	148	141	137	132	131	[illegible]														
20	288	266	248	247	224	216	208	202	194	192	184	178	173	165	157	152	142	144	[illegible]														
25	356	332	308	292	282	276	260	251	244	240	230	222	216	206	197	189	183	180	170														
30	435	392	370	356	338	324	312	301	291	288	276	252	240	241	236	221	220	216	240														
35	550	459	432	410	393	378	364	352	340	346	322	317	302	288	271	265	256	252	258														
40	....	....	495	467	450	432	417	402	388	385	368	356	346	329	314	305	293	288	272	266	258												
45	....	....	557	525	505	486	460	452	438	435	414	400	389	370	354	342	333	324	[illegible]	[illegible]	[illegible]												
50	..	....	617	584	562	540	520	503	485	480	460	445	432	412	391	376	366	366	340	332	322												
55	....	....	680	642	617	594	572	552	534	521	505	490	475	452	432	417	402	396	374	366	354												
60	....	...	740	700	672	648	624	603	582	575	555	533	520	498	473	448	440	432	401	398	381												
65	...	...	802	760	730	702	675	652	641	625	598	580	562	535	510	492	476	467	442	437	419												
70	....	....	862	817	785	755	730	705	680	672	642	627	605	575	556	541	517	504	473	463	452												
75	...	....	925	875	840	810	782	752	727	720	699	663	648	617	596	568	540	540	510	490	484												
80	..	...	987	934	897	865	831	803	777	767	736	715	692	658	627	600	590	576	544	532	516												
85	....	..	1026	999	955	917	885	855	825	816	781	757	748	700	667	641	627	612	578	565	548												
90	...	..	1123	1051	1016	972	936	904	875	864	825	800	777	740	707	682	660	648	612	597	580												
95	...		1170	1108	1067	1003	999	955	922	912	875	846	827	782	746	720	696	684	647	636	612												
100	...	....	1235	1166	1123	1080	1040	1005	970	960	922	890	865	822	786	757	732	720	680	665	645												
105	....	....	1296	1225	1178	1118	1090	1053	1025	1000	968	936	901	863	825	796	768	736	711	697	677	657	648										
110	....	....	1353	1254	1238	1119	1115	1105	1097	1055	1010	980	956	903	865	834	801	792	749	732	710	689	689										
115	....	....	1411	1340	1295	1240	1200	1150	1102	1100	1006	1012	998	948	902	870	840	825	782	764	741	720	716										
120	..	....	1483	1400	1348	1293	1250	1208	1155	1150	1102	1070	1038	987	942	910	880	805	816	797	774	752	740										
125	....	....	1541	1451	1400	1350	1300	1250	1210	1200	1150	1115	1080	1041	982	947	915	906	850	830	806	782	791										
130	....	....	1630	1518	1451	1416	1382	1308	1281	1255	1195	1159	1122	1075	1021	985	950	937	884	865	851	815	802										
135	....	....	1665	1570	1512	1451	1408	1358	1310	1298	1240	1203	1166	1120	1031	1022	999	972	936	897	870	843	824										
140	....	....	1728	1635	1570	1510	1450	1405	1339	1342	1287	1248	1210	1150	1094	1051	1022	1008	952	940	902	877	865										
145	....	....	1790	1691	1630	1562	1510	1452	1408	1390	1330	1290	1253	1195	1137	1094	1051	1037	987	962	935	907	898										
150	...	....	1850	1750	1656	1620	1560	1509	1452	1440	1380	1335	1295	1274	1152	1178	1094	1076	1019	997	967	940	925										
155	....	....	1915	1810	1740	1672	1615	1568	1502	1488	1425	1387	1340	1267	1216	1166	1135	1108	1054	1022	1000	970	957										

CROSS SECTIONAL AREA OF CHIMNEYS, IN SQUARE INCHES, FOR VARIOUS HEIGHTS AND HORSE POWERS

	Height of Chimney, in Feet																																
Horse-power	38	44	50	56	60	65	70	75	80	85	90	95	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
160	....	....	1975	1870	1795	1730	1665	1608	1552	1535	1470	1425	1382	1329	1253	1210	1166	1152	1080	1065	1036	1000	988										
165	....	....	2020	1925	1850	1780	1720	1658	1600	1585	1518	1470	1428	1383	1296	1252	1209	1189	1135	1098	1066	1045	1020			....	....	....	....	....	....	....	....
178	....	....	2100	1985	1910	1835	1770	1710	1750	1630	1565	1518	1444	1400	1355	1290	1245	1225	1158	1130	1097	1065	1005	1012	992	980	948	....	....	....	....	....	....
175	....	....	2160	2042	1962	1890	1820	1755	1700	1680	1610	1560	1515	1444	1372	1328	1280	1260	1190	1162	1130	1078	1080	1042	1022	1009	975	....	....	....	....	....	....
180	....	....	2221	2100	2010	1945	1875	1810	1750	1730	1652	1602	1555	1485	1415	1364	1320	1298	1235	1198	1160	1128	1111	1072	1050	1038	1002	....	....	....	....	....	....
185	....	....	2280	2160	2080	2000	1930	1860	1795	1775	1700	1635	1600	1522	1451	1405	1355	1332	1259	1230	1202	1160	1042	1102	1080	1061	1031	....	....	....	....	....	....
190	....	....	2342	2220	2124	2065	1980	1910	1840	1820	1760	1695	1642	1565	1492	1440	1392	1390	1292	1262	1225	1190	1172	1132	1110	1095	1060	....	....	....	....	....	....
195	....	....	2405	2280	2245	2102	2015	1960	1895	1870	1795	1740	1688	1603	1530	1478	1428	1405	1328	1295	1258	1220	1201	1161	1138	1122	1088	....	....	....	....	....	....
200	....	....	2470	2330	2240	2160	2080	2005	1940	1920	1838	1780	1730	1648	1570	1515	1462	1440	1360	1330	1290	1252	1235	1192	1168	1151	1115	....	....	....	....	....	....
210	....	....	2590	2441	2348	2270	2190	2158	2018	2008	1930	1870	1815	1730	1650	1591	1538	1511	1430	1395	1352	1315	1295	1250	1225	1210	1170	....	....	....	....	....	....
220	....	....	2710	2570	2470	2380	2290	2101	2178	2101	2010	1960	1901	1810	1730	1670	1610	1585	1500	1461	1420	1378	1358	1310	1285	1268	1228	....	....	....	....	....	....
230	....	....	2828	2680	2568	2482	2385	2305	2215	2202	2108	2042	1989	1891	1805	1742	1685	1658	1568	1529	1482	1440	1420	1370	1342	1325	1282	....	....	....	....	....	....
240	....	....	2960	2800	2649	2585	2500	2405	2315	2302	2202	2120	2068	1975	1885	1820	1758	1729	1642	1595	1548	1502	1480	1430	1400	1382	1338	....	....	....	....	....	....
250	....	....	3080	2910	2801	2700	2602	2504	2412	2400	2300	2215	2160	2060	1964	1878	1830	1800	1709	1661	1611	1565	1542	1490	1460	1440	1392	1368	1350	1315	....	....	....
260	....	....	3205	3020	2920	2810	2710	2605	2510	2498	2385	2308	2250	2120	2020	1970	1905	1872	1770	1730	1675	1630	1605	1550	1518	1500	1450	1421	1405	1370	....	....	....
270	....	....	3340	3150	3000	2918	2810	2708	2610	2590	2480	2410	2318	2220	2120	2024	1975	1945	1838	1795	1740	1691	1668	1610	1575	1555	1505	1475	1460	1420	....	....	....
280	....	....	3460	3270	3120	3021	2908	2808	2710	2682	2565	2488	2420	2302	2200	2120	2045	2018	1905	1860	1805	1755	1730	1670	1635	1612	1561	1530	1510	1475	....	....	....
290	....	....	3580	3380	3250	3130	3020	2910	2810	2790	2660	2580	2510	2390	2280	2200	2120	2090	1915	1930	1870	1825	1790	1730	1692	1670	1615	1585	1515	1530	....	....	....
300	....	....	....	....	....	3220	3110	3009	2905	2880	2760	2668	2548	2465	2360	2268	2200	2160	2040	1995	1935	1880	1850	1788	1750	1730	1672	1640	1620	1580	....	....	....
310	....	....	....	....	....	3320	3210	3108	3000	2969	2822	2760	2680	2550	2428	2350	2270	2238	2110	2096	2000	1940	1915	1848	1810	1785	1730	1695	1672	1630	....	....	....
320	....	....	....	....	....	3448	3322	3230	3110	3070	2940	2850	2760	2628	2518	2422	2341	2300	2168	2121	2060	2000	1975	1910	1815	1840	1780	1750	1725	1685	....	....	....
330	....	....	....	....	....	3562	3450	3320	3210	3170	3030	2920	2845	2712	2590	2500	2408	2380	2221	2190	2130	2064	2020	1965	1930	1900	1840	1805	1780	1750	....	....	....
340	....	....	....	....	....	3685	3540	3420	3300	3260	3130	3022	2940	2800	2681	2590	2490	2450	2318	2260	2190	2130	2100	2003	1859	1960	1895	1860	1835	1790	....	....	....
350	....	....	....	....	....	3780	3640	3510	3400	3360	3250	3120	3020	2880	2745	2650	2560	2520	2380	2320	2260	2190	2160	2090	2041	2030	1950	1912	1890	1845	....	....	....
360	....	....	....	....	....	3890	3750	3620	3500	3460	3310	3208	3110	2960	2830	2730	2640	2590	2450	2390	2320	2248	2220	2140	2100	2080	2008	1970	1945	1900	....	....	....
370	....	....	....	....	....	4000	3850	3720	3590	3525	3400	3300	3200	3020	2910	2800	2710	2660	2520	2460	2380	2820	2280	2200	2160	2130	2060	2020	2000	1950	....	....	....
380	....	....	....	....	....	4100	3960	3820	3686	3655	3500	3390	3280	3150	2980	2880	2780	2740	2580	2520	2445	2380	2340	2260	2220	2190	2120	2080	2050	2000	....	....	....
390	....	....	....	....	....	4200	4052	3920	3780	3740	3581	3480	3380	3210	3060	2960	2860	2810	2560	2598	2520	2440	2410	2320	2280	2242	2180	2130	2110	2060	....	....	....
400	....	....	....	....	....	....	4160	4020	3880	3840	3680	3560	3460	3300	3120	3030	2930	2880	2720	2660	2580	2500	2461	2370	2340	2300	2230	2190	2160	2110	2070	....	....
410	....	....	....	....	....	....	4275	4120	3980	3940	3770	3650	3540	3380	3220	3110	3000	2960	2790	2720	2640	2565	2530	2440	2400	2360	2280	2240	2240	2160	2120	....	....
420	....	....	....	....	....	....	4375	4220	4075	4040	3860	3740	3630	3460	3300	3180	3080	3022	2860	2800	2710	2630	2590	2500	2450	2420	2330	2300	2270	2218	2170	....	....
430	....	....	....	....	....	....	4475	4320	4175	4120	3950	3830	3720	3540	3380	3260	3150	3100	2920	2860	2770	2690	2660	2560	2510	2480	2400	2350	2320	2265	2220	....	....
440	....	....	....	....	....	....	4580	4425	4275	4224	4050	3920	3800	3620	3460	3340	3220	3170	3000	2920	2840	2760	2720	2620	2570	2540	2450	2410	2380	2320	2280	....	....
450	....	....	....	....	....	....	4675	4525	4375	4320	4148	4000	3890	3700	3530	3410	3300	3240	3060	2990	2900	2820	2780	2680	2630	2590	2510	2460	2370	2370	2330	2290	2248
460	....	....	....	....	....	....	4785	4625	4470	4425	4225	4100	3980	3780	3620	3490	3370	3318	3130	3060	2961	2880	2840	2740	2680	2650	2560	2518	2430	2420	2380	2340	2300
470	....	....	....	....	....	....	4900	4725	4550	4520	4325	4190	4070	3870	3700	3560	3440	3380	3200	3120	3030	2940	2900	2800	2740	2710	2620	2570	2540	2480	2430	2390	2340
480	....	....	....	....	....	....	5000	4825	4650	4600	4420	4275	4150	3950	3770	3640	3520	3460	3260	3190	3100	3000	2960	2860	2800	2780	2680	2620	2589	2525	2480	2440	2400
490	....	....	....	....	....	....	5100	4925	4750	4700	4510	4350	4248	4048	3850	3720	3590	3530	3340	3260	3160	3070	3020	2920	2860	2820	2730	2680	2650	2580	2540	2490	2450
500	....	....	....	....	....	....	5200	5025	4850	4800	4600	4450	4325	4120	3930	3790	3660	3600	3400	3320	3220	3130	3090	2980	2920	2880	2790	2740	2700	2640	2590	2540	2500
510	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
520	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

CROSS-SECTIONAL AREA OF CHIMNEYS, IN SQUARE INCHES, FOR VARIOUS HEIGHTS AND HORSE-POWERS

Milne's rule is the same as Tredgold's, only in place of 112 he uses 280. *Example:*

$$\frac{40 \times 280}{\sqrt{70}} = 1350 \text{ sq. in.}$$

or 9.54, 144 sq. ft.

Murray's rule—18 sq. in. for 12 lbs. of coal.

From Box on Heat—H. P. 42.3, size of chimney at top, 2 ft.; height, 80 ft.

From Babcock & Wilcox—H. P. 41, height of chimney 70 ft.; actual square feet, 2.41.

The writer—40 H. P.; height of chimney, 70 ft.; 417 sq. in., or 2.9 sq. ft.

Rule of thumb is that the size of the flue should be equal to the area of all the tubes.

Another rule for chimneys for horizontal flue boilers is that the chimney should be from 60 to 80 ft. high, and have an area equal to half the square of the diameter of one of the tubes multiplied by the number of tubes.

I have stated only a few, but, I think, enough to show what a variety there is for one to choose from

The accompanying table is compiled from the following rule: The area of a chimney in feet when above 10 H. P. should be 0.6 times the horse power divided by the square root of the height of the chimney in feet. *Example:*

$$\frac{40 \times 0.6}{\sqrt{70}} = 2.9 \text{ sq ft.}$$

This should be reduced to square inches, as the table is in square inches.

Centrifugal Fan Testing

By G. L. Copping

Interesting comments on methods of testing centrifugal fans, as well as the particulars of a test with a fan of this type delivering air at a medium pressure, are contained in a paper read by G. L. Copping, of London, at the October, 1911, meeting of the (British) Institution of Heating and Ventilating Engineers. The author emphasized the effect which a very slight variation in the shape of the blades has upon the capacity of a fan, a practically unnoticeable alteration of their angles to the radii—which might be due to careless fitting—being enough to alter the mechanical efficiency by 5% or more.

The chief data to be ascertained by testing were explained, together with the apparatus which, in the author's opinion, were most reliable for testing purposes, including the instruments available for measuring air speeds, either mechanical recorders or hydraulic recorders, chief among the first class being the anemometer.

Experience, however, shows that an error up to about 30% of the air speed might exist with this instrument, although it might be apparently in perfect order. Therefore, frequent calibration is necessary with this as well as all types of instruments belonging to the same class. Instruments of the hydraulic recorder class contain no moving parts excepting the liquid used, so that many errors which affected mechanical recorders are absent. But even here there are certain sources of error, the chief of which are capillarity of the liquid and errors in the design of the instrument which is placed in the air current to transmit the pressure to the liquid. To overcome the first-mentioned trouble, alcohol is the liquid usually employed. The second cause of error, however, necessitated much experimental work before a satisfactory instrument was obtained.

PRELIMINARY PROBLEMS REQUIRING SOLUTION

The problems which had to be solved were, first, how to measure accurately the static pressure of the air, without the speed of the air influencing the reading; and, second, how to measure the air speed correctly. The

author referred to some exhaustive tests recently made in Berlin by Dr. Brabbee by means of an instrument constructed of Pitot tubes, and this he proceeded to describe; passing on to another form of apparatus for converting air pressure into liquid pressure, and known as the micromanometer—the invention of R. Fuess, of Berlin.

As to the method of driving and of obtaining the net power taken by the fan itself, the author said many different arrangements had been tried with more or less accurate results. If it was more convenient to drive it by belt from line shafting, a spring coupling might be inserted between the fan spindle and the spindle upon which the driven pulley was mounted.

Arrangements could be made to measure the compression of the springs in the coupling when the fan was running, and from these measurements and the revolutions made by the coupling the power transmitted to the fan spindle could be calculated. The more usual method, however, is to drive the fan by a direct-coupled electric motor. The power developed by the electric motor may be obtained in three ways:

THREE METHODS OF DETERMINING POWER DEVELOPED BY MOTOR

(1) By calculation from the electric power supplied to the motor while driving the fan, and running under no load, and from the characteristic of the motor.

(2) By calculations made from tests with a Prony or other brake while the motor is running at the same speed and taking the same electric power as when driving the fan.

(3) By direct measurement of the torque between the motor armature and field, and calculation involving this torque and the revolutions.

In the author's opinion the third method is the most reliable and the most convenient for obtaining correctly the net power taken by the fan.

The bearings in which the armature turned, rested in ball bearings so that the motor field or casing was free to revolve. One end of a lever was screwed into the casing and a scale pan hung from the other. A short-weighted lever was screwed into the opposite side of the motor to counterbalance the above-mentioned lever and scale pan, so that when there was no current running through the motor, the latter was balanced and had no tendency to revolve either way. When the current was switched on, just sufficient weights were placed in the scale pan to balance the torque between the armature and field. The torque could then be calculated from the total weight added and the length of the lever. The horse-power developed by the motor was easily calculated from the torque and number of revolutions.

To ensure accuracy a plate with a line across it was screwed on top of the motor casing and a pointer fixed over this plate to a band passing over, but in no way attached to the motor. A microscope was also fixed to this band, by the aid of which the small deviations might be observed, and the weights in the scale pan adjusted until the line on the plate was immediately below the pointer.

A motor constructed and arranged in that manner was especially recommended for accurately obtaining small powers, although it is not so necessary for fans taking larger horse-power. By using a motor so arranged the accuracy of the power calculated does not depend upon the characteristic curve of the motor or any electric measurements.

ARRANGEMENTS FOR TEST

An illustration was submitted showing a fan under test with a sheet-iron duct connected to its outlet, in which duct the air measurements were taken by means of a double-pressure tube shown fixed in position passing through the side of the duct about halfway along its length. The frame at the end of the duct furthest from the fan carried a pair of sliding doors, with which the area of outlet from the duct could be regulated.

With reference to the arrangement of the fan and ducts, it is a question, the author stated, whether the air reading should be taken on the discharge side, feed side, or both sides of

the fan. Obviously the results obtained are influenced by the efficiency of the air inlet and outlet openings to and from the fan.

In Mr. Copping's opinion the best results can be obtained by connecting up both openings to ducts the same size as these openings, and measuring in both ducts.

The air inlet and outlet openings are then at the ends of the inlet and outlet ducts furthest from the fan, so that their influence on the capacity of the fan is recorded by the readings taken in the duct.

RESULTS OF TESTS

After illustrating and explaining certain methods of measuring the different pressures on the feed and discharge sides of a single inlet centrifugal fan, the author showed by plotted curves the efficiency of a 15-in. double-inlet Keith fan at any relationship between total water gauge and air-volume. The most interesting feature of the chart, he pointed out, was the shape of the total water-gauge curves. The variation of total water gauge from the average level of the curves was nowhere very great, from static non-delivery up to the largest volume. A slight fall was noticeable when the fan began to deliver air, after which it rose to its highest level at about maximum mechanical efficiency, and then fell at a constantly increasing angle, showing that the maximum mechanical and manometric efficiencies almost coincided, as was to be expected. The fall in total pressure referred to was found to take place with many differently designed centrifugal fans, but the subsequent rise was not so often met with.

Another interesting feature was the variation of mechanical efficiency with the speed of the fan. Although it was usual to assume that the power taken and total water gauge varied as the cube and square respectively, and the air volume directly as the fan speed, careful tests appeared to show that such assumptions were not strictly accurate. There appeared to be with each size and type of fan a certain speed at which it was possible to obtain a higher mechanical efficiency than at any higher or lower speed. From the tests with the Keith fan referred to, the most suitable speed seemed to be somewhere about 1600 R. P. M.

This feature offered scope for investigation, as it would be useful to know the causes which influenced this speed of highest efficiency, especially now that greater accuracy was required from fan makers in their capacity lists, and more economy in working was expected. When taking gauge readings it would usually be found that, whereas the readings across the horizontal width of the tube are fairly consistent, those taken down the vertical depth vary more or less. This seems to be due to incorrect construction of the fan casings, but investigation of this point would undoubtedly prove interesting. A further point requiring more study is the relative efficiencies of double and single-inlet fans. The author's own tests all went in favor of single-inlet fans, although this seemed the opposite to what would be expected.

German Ideas for Heating and Ventilation of School Buildings

At the meeting of the Congress for Heating and Lighting, held in Dresden, Germany, June 14 last, Schumacher, of Berlin, read a paper on the above topic, in which he laid down the following general principles:

(1) The normal temperature of class-rooms should be 18° C. = 64.4° F. at the height of the scholar's head; temperatures below 16° C. = 60.8° F. or above 20° C. = 68° F. are to be avoided.

(2) Where the arrangements are properly made, hot water or low-pressure steam is advisable.

(3) Where double sash is used, the radiators may be on the inner walls.

(4) Artificial ventilation is unques-

tionably necessary. The minimum amount permissible is thorough replacement of the entire volume of air every 20 minutes.

(5) Where the air for ventilation is cooler than that in the room, it must be equally distributed.

(6) Fan ventilation is preferable to any other system.

(7) Air outlets are necessary; but for pressure ventilation the outlets should provide for a maximum of half the amount of newly introduced air. Overhead outlets are necessary only when the lighting is by gas, or when there is no cooling by the introduction of cold air.

(8) Thorough ventilation of the class-rooms for some minutes in the pauses is recommended, even for schools with good ventilating appliances.

(9) Opening the windows during class-time is under no circumstances permissible.

(10) Appliances for moistening the air are absolutely unnecessary.

(11) Where there is no automatic apparatus to insure a regular temperature, attention to the radiators and ventilators should not be by teachers or scholars, but by employers. Such apparatus is highly recommended.

(12) In large cities, teachers of heating are necessary; who should see that the heating plants are properly attended to.

New Humidity Charts and Formulas*

BY WILLIS H. CARRIER

A specialized engineering field has recently developed, technically known as air conditioning, or the artificial regulation of atmospheric moisture. The application of this new art to many varied industries has been demonstrated to be of greatest economic importance. When applied to the blast furnace, it has increased the net profit in the production of pig iron from $0.50 to $0.70 per ton, and in the textile mill it has increased the output from 5% to 15%, at the same time greatly improving the quality and the hygienic conditions surrounding the operative. In many other industries, such as lithographing, the manufacture of candy, bread, high explosives and photographic films, and the drying and preparing of delicate hygroscopic materials, such as macaroni and tobacco, the question of humidity is equally important. While air conditioning has never been properly applied to coal mines, the author is convinced that if this were made compulsory, the greater number of mine explosions would be prevented.

Although of so much practical as well as scientific importance, the laws governing many of the phenomena of atmospheric moisture are but partially understood, while the present engineering data pertaining thereto are both inaccurate and incomplete. Accepted data used in psychrometric calculations are based largely on empirical formulæ, which are incorrect as well as limited in their range. Recent investigators have determined the most important properties of water vapor with final accuracy. At the same time, sufficient error has been shown in previous steam data, especially at atmospheric temperatures, to warrant the revision of all calculations based thereon.

It is the purpose of this paper to apply these final data to the development of rational formulæ for the solution of all problems pertaining to the phenomena of atmospheric moisture as related to psychrometry and to air conditioning. Original data are given in proof of fundamental relations as well as in determination of errors in standard psychrometric instruments. The author hopes these results may prove to be of permanent value.

*Condensed from a paper on "Rational Psychrometric Formulæ; Their Relation to the Problems of Meteorology and of Air Conditioning," read at the annual meeting of the American Society of Mechanical Engineers, New York, December 5-8, 1911.

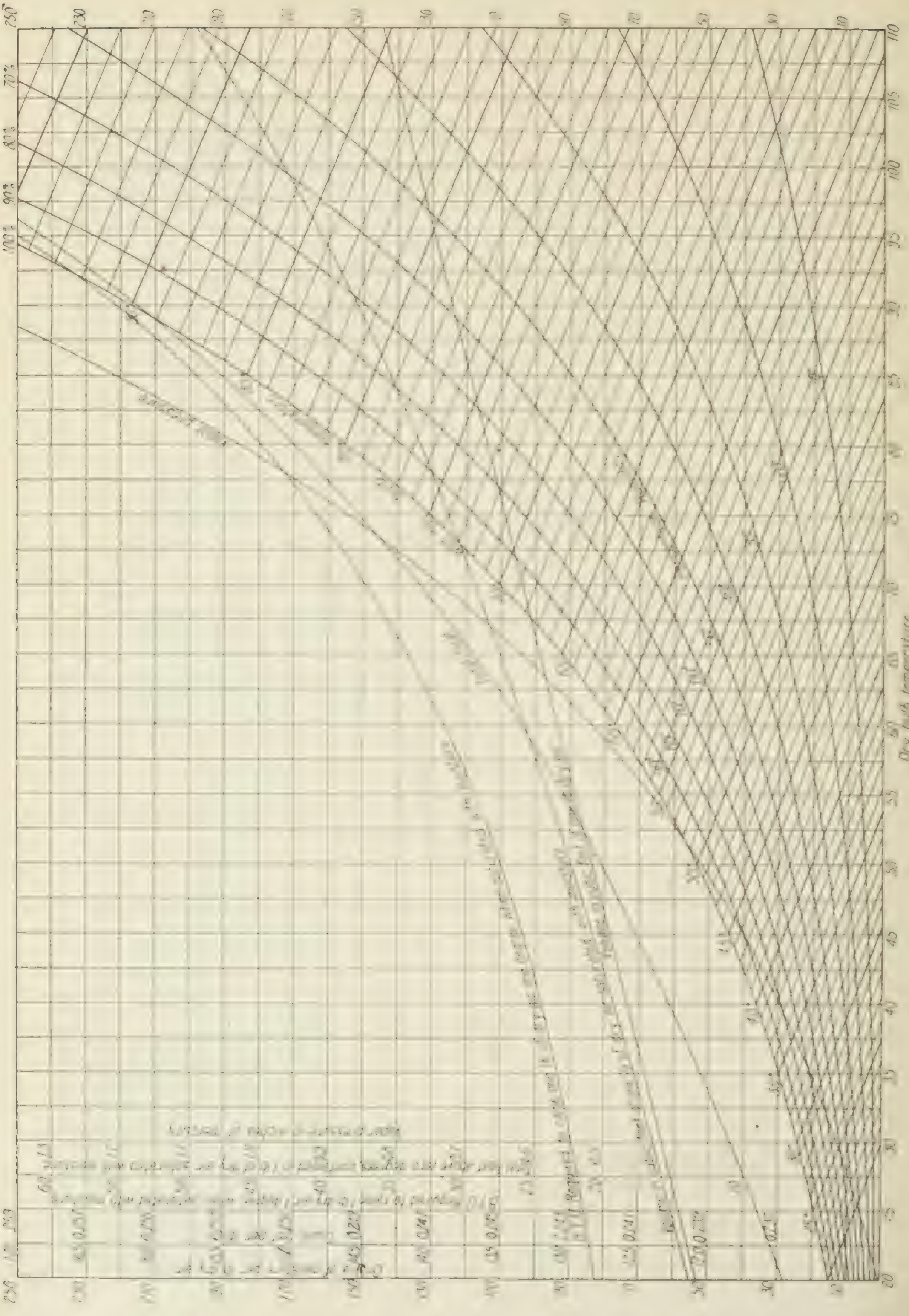

FIG. 1—PSYCHROMETRIC CHART

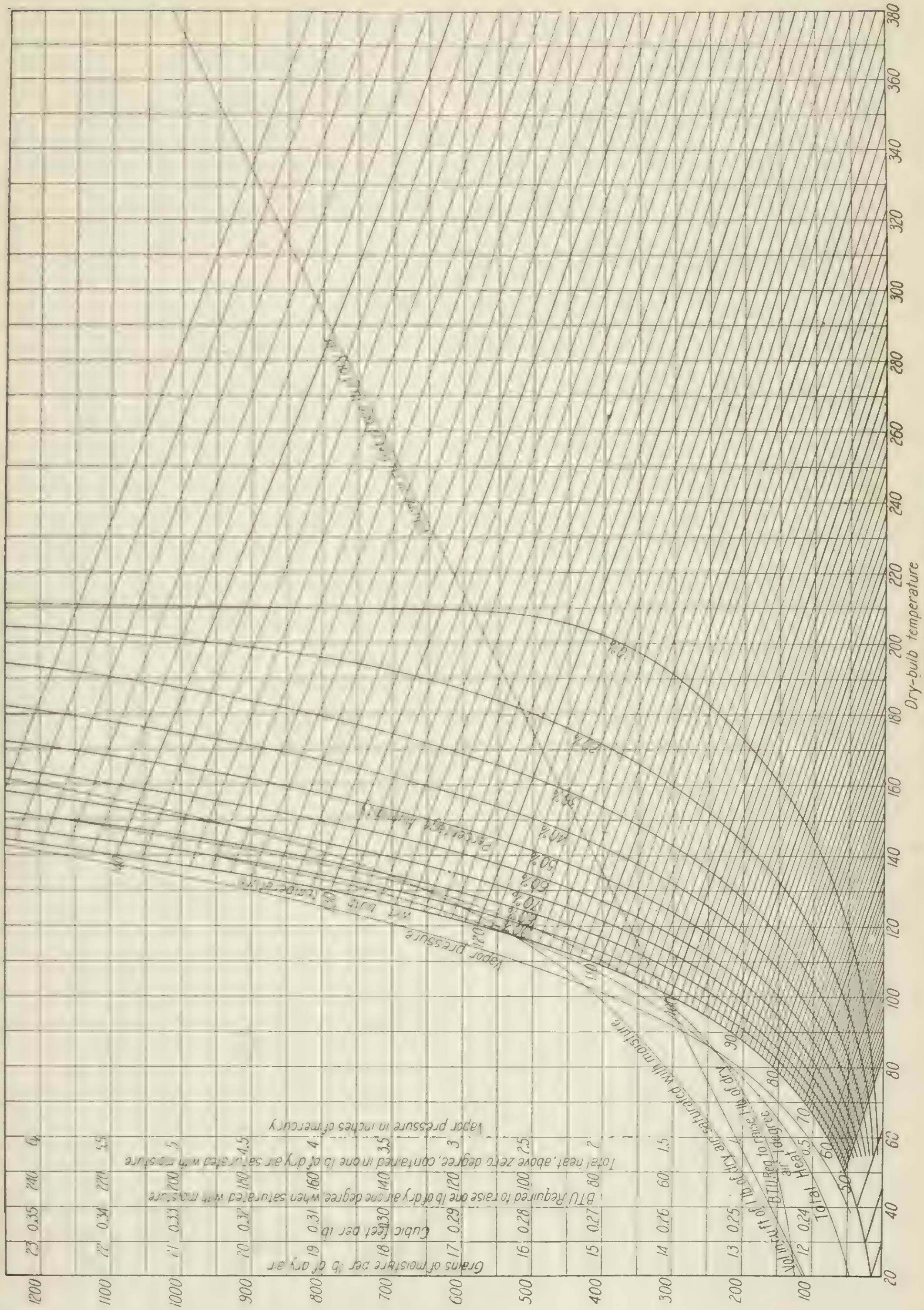

FIG. 2—PSYCHROMETRIC CHART

VAPOR PRESSURE AND LAW OF PARTIAL PRESSURES

Water vapor exists in the air purely as a mixture in relation to its other elements. This vapor, according to Dalton's law, is capable of exerting a certain maximum vapor pressure dependent entirely on its temperature and regardless of the presence of other gases or vapors. For example, assume 1 cu. ft. saturated with vapor of alcohol at 100° C. having a vapor pressure of 1697.6 mm., and add isothermally to this 1 cu. ft. saturated with water vapor at 100° C. having a vapor pressure of 760 mm. This will give 1 cu. ft. of the mixture saturated with both water vapor and alcohol vapor at 100° C., having as a total pressure the sum of the two separate saturated vapor pressures, or 2457.6 mm. Similarly, an equal volume of a third saturated vapor might be added without affecting the other two. But if, on the other hand, it is attempted to include isothermally an additional amount of either of the saturated vapors, a corresponding condensation of the particular vapor added would result. In the same manner, an unlimited amount of a gas, such as air, could be added isothermally to a cubic foot of water vapor without affecting its condition of saturation, giving a combined pressure equal to the gas pressure plus the vapor pressure.

The established temperature-pressure relationship of saturated water vapor is shown on the charts, Figs. 1 and 2. This is the well-known temperature-pressure curve of steam.

PARTIAL SATURATION

When the temperature of a definite weight of saturated vapor is increased isobarometrically, it is said to be superheated. Its specific volume is increased, in accordance with the law of gases, in direct proportion to the increase of absolute temperature, while its density is changed in an inverse proportion — that is, $\frac{D_2}{D_1} = \frac{T_1}{T_2}$, where D_1 and D_2 are the densities corresponding to the absolute temperatures T_1 and T_2, respectively, and $(T_2—T_1)$ is the degree of superheat. If D_2 is the density of saturated vapor at temperature T_2, then the ratio $\frac{D_2}{D_1}$ is said to be the per cent. of saturation, or, more exactly, the per cent. of isother-

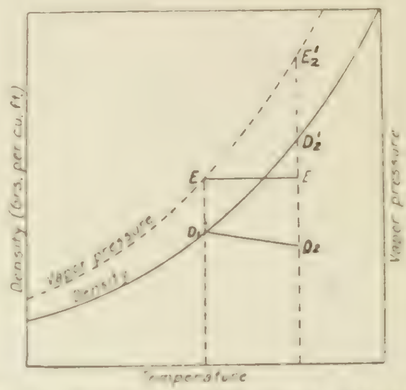

FIG. 3—TEMPERATURE-DENSITY DIAGRAM

mal saturation. When these relationships are considered with respect to water vapor in air, this ratio is termed the per cent. of relative humidity, while the densities D_1, D_2, D'_2, etc., customarily expressed in grains of moisture per cubic foot, are termed absolute humidities.

DEW POINT

It should be noted that although the total weight of the water vapor remains the same, the absolute humidity D_2 is less than the absolute humidity D_1. However, if water vapor, or air containing water vapor, having a temperature T_2 and an absolute humidity of D_2, be cooled to T_1, it will become saturated, and if cooled further, moisture will be precipitated. Therefore, T_1 is termed the dew point of air having a temperature T_2 and an absolute humidity, D_2, or a corresponding relative humidity, $\frac{D_2}{D'_2}$. Therefore, the dew point may be defined as the minimum temperature to which air of a given moisture content may be cooled without precipitation of moisture.

Usually it is more convenient to

determine the absolute and relative humidities from the temperature-pressure curve by comparing the vapor pressures. The per cent. of humidity is $\frac{D_2}{D'_2}$, but it may also be shown to be equal to $\frac{e_1}{e'_2}$; i. e.,

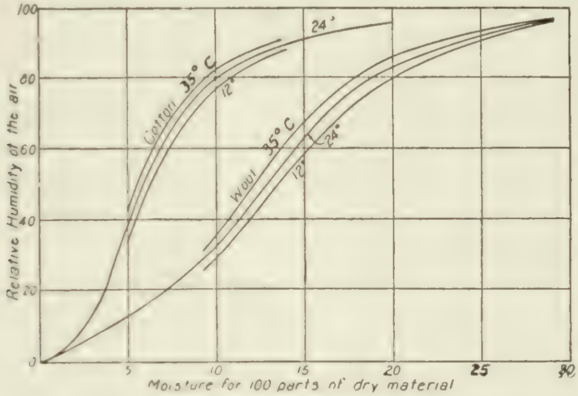

FIG. 4—EFFECT OF HUMIDITY ON MOISTURE CONTENT OF TEXTILES

$$\text{per cent. humidity} = \frac{e_1}{e'_2} = \frac{D_2}{D'_2} \quad \ldots . [1]$$

where e_1 is the pressure of saturated vapor corresponding to the dew point T_1, and e'_2 is the vapor pressure at saturation corresponding to temperature T_2. It also follows that

$$D_2 = D'_2 \times \frac{e_1}{e'_2} \quad \ldots\ldots [2]$$

METHODS OF MEASURING ATMOSPHERIC HUMIDITY

Determinations of atmospheric moisture may be made by four distinct methods:

Chemical Method.—A measured quantity of air is drawn through some de-hydrating solution, such as concentrated sulphuric acid, until the moisture is completely removed and the increase in the weight of the solution noted.

Hygroscopic Method.—This method is chiefly useful in an approximate determination of the relative humidity directly. It is known that nearly all animal and vegetable substances containing albumen or cellulose, and also many mineral salts are very sensitive to changes in atmospheric moisture. The moisture content of such materials at equilibrium is found to bear a direct relation to the existing amount of moisture in the atmosphere.

The per cent. of moisture which they will freely absorb, however, is not exactly the same for the same percentage of humidity for different temperatures. This relationship of moisture content of various textiles to different atmospheric humidities and temperatures has been very thoroughly investigated by Schloessing in France.

It is, therefore, to be seen that the moisture content of the air will be approximately indicated by measuring the increase in weight of a skein of silk, or other textile, whose dry weight has been definitely determined. Such an instrument for the measurement of humidity has been devised by William D. Hartshorne, of Lawrence, Mass.

The action of the hair hygrometer depends upon its linear expansion, due both to humidity and temperature. The accuracy of this type of hygrometer was thoroughly investigated by Regnault. It may be calibrated to give a fairly accurate indication of humidity throughout a considerable range of temperature. However, the elasticity of the hair or any similar fiber is not permanent and any instrument operating on this principle requires frequent calibration and readjustment. Therefore, it can be used

only in connection with some instrument giving absolute determinations.

In his investigations of atmospheric humidity, Regnault found that a solution of calcium chloride exposed to the air would assume a density in proportion to the relative humidity. If the air became drier, it would evaporate moisture from the solution, increasing its density. If, on the other hand, the humidity of the air increased, moisture would be absorbed by the solution until it reached an equilibrium.

A test was made by the writer in May, 1902, to determine the moisture-absorbing properties of calcium-chloride brine for the purpose of air conditioning. It was found that with a constant humidity of the air, the rate of absorption varied directly in proportion to its change in density, and that the density of the solution decreased to a point where absorption stopped. In connection with this test an interesting phenomenon was observed relative to the conversion of the latent heat into sensible heat of the moisture thus absorbed. By measuring the increase in temperature, it was found possible to account very closely for the calculated latent heat of the moisture removed. The temperature of the solution was, furthermore, considerably higher than the final temperature of the air. This may be explained by the assumption that the absorption and consequent heat transformation occurred at the surface film where the air in the film and the liquid were heated to an equal temperature, and that not all of the air came into direct contact with the liquid. This is the direct inverse of phenomena occurring in evaportion with incomplete saturation. Here the temperature of the air is lowered to correspond with the increase in latent heat by evaporation, while the water always remains at a lower temperature than the partially saturated air.

In 1909, in connection with a test made upon a humidifying plant for conditioning tobacco, similar phenomena were noted. It was found that the ventilation of cool, dry tobacco with moist air produced a rapid rise in temperature both of the air and of the tobacco, which rose to a much higher temperature than the air.

Dew-Point Method.—The dew-point method was first brought into use by Daniels and by Regnault, and adopted by the United States Weather Bureau in the determination of the values used in their psychrometric tables. The dew point is measured directly by observing the temperature at which moisture begins to form upon an artificially cooled mirror surface. Determination by this method is extremely delicate, and when suitable precautions are taken is considered very accurate. However, it is questionable whether the true dew point is ever quite as low as indicated by this method.

Evaporative or Psychrometric Method.—The evaporative or psychrometric method has not heretofore, to the writer's knowledge, been definitely accepted as an absolute means of moisture determination, but, as will be demonstrated, is independent of and preferable to all other methods in scope and accuracy. It is of special interest in relation to the art of air conditioning, because the same fundamental phenomena are involved and subject to the same theory. It is of service not only in the art of air conditioning, but also a departure in the science of meteorology. It provides a method, remarkable for simplicity and accuracy, for the determination of the specific heat of air, which present methods have failed to establish, within an unquestioned accuracy of 2%.

This method of moisture determination depends upon the cooling effect produced by the evaporation of moisture in a partially saturated atmosphere. This is usually measured by covering the bulb of an ordinary mercurial thermometer with a cloth or wick saturated with water and comparing its temperature with that of a thermometer unaffected by evaporation. The covered bulb is termed the wet-bulb thermometer, and the difference between the wet and dry-bulb readings is termed the wet-bulb depression. The temperature of the

wet bulb is affected in a measure by radiation from surrounding objects. It is, therefore, very susceptible to air currents which serve to increase the evaporation and therefore decrease the percentage of error due to radiation. On this account, the earlier and more convenient form of hygrometer using a stationary wet bulb is very unreliable, considerable correction being necessary for radiation. The sling psychrometer advocated by the United States Weather Bureau overcomes this error to a great extent by increasing the ventilation and consequent rate of evaporation to such a degree that the heat received by radiation becomes a small percentage of the total heat transformation.

The tables of the United States Weather Bureau based upon an empirical formula deduced by Prof. Wm. Ferrel from simultaneous determinations with the sling psychrometer and the dew-point instrument are more reliable, and are now generally used. The limitations of this formula are admitted, since it is held to be correct only over the range of observation from which it was deduced, including simply temperatures below 120° F.

Professor Ferrel's formula, as given in the tables of the United States Weather Bureau, is:

$$e = e' - (0.000367\,P)\,(t - t')\left(1 + \frac{t' - 32}{1571}\right)$$

where

e = partial pressure of the moisture in the air, which also = vapor pressure corresponding to the dew point,

e' = the vapor pressure corresponding to saturation at wet-bulb temperature t',

P = the barometric pressure,

t = dry-bulb temperature in deg. F.

t' = wet-bulb temperature in deg. F.

The temperature of the dew point is found by selecting the temperature corresponding to the pressure e, from the temperature-pressure diagram or table. The per cent. of relative humidity is $R = \frac{e}{e_t}$, where e_t is the vapor pressure corresponding to the dry-bulb temperature t, as previously demonstrated. The absolute humidity expressed in grains of moisture per cubic foot is then determined by multiplying the grains of moisture per cubic foot corresponding to saturation at dry-bulb temperature by the per cent. of relative humidity thus determined.

The writer would substitute for such an empirical formula a rational one, having a thermodynamic basis—that is, a formula depending upon the transformation of sensible heat into latent heat in the adiabatic saturation of dry air.

The author first observed that the wet-bulb temperature given in the psychrometric tables of the United States Weather Bureau agreed substantially with the computed temperature at which air of a known temperature and moisture content would become saturated adiabatically —i. e., without the addition or subtraction of heat. These calculations were made by the writer in 1903, in determining the moisture-absorbing capacity of air in connection with the fan systems of drying. Subsequently, this relationship was still further investigated and thoroughly established in connection with the system of air conditioning introduced by the writer.

Tests upon progressive fan-system dry kilns in 1904 disclosed the fact that the wet-bulb temperature was substantially the same in all parts of the kiln regardless of the drop in temperature due to moisture absorption, a phenomenon which logically results from the identity of the wet-bulb temperature and the temperature of adiabatic saturation.

PSYCHROMETRIC PRINCIPLES

The following principles underlie the entire theory of the evaporative method of moisture determination, as well as of air conditioning:

(*A*) When dry air is saturated adiabatically the temperature is reduced as the absolute humidity is increased, and the decrease of sensible heat is exactly equal to the simultaneous increase in latent heat due to evaporation.

(*B*) As the moisture content of air is increased adiabatically the temperature is reduced simultaneously until the vapor pressure corresponds to the temperature, when no further heat metamorphosis is possible. This ultimate temperature may be termed the temperature of adiabatic saturation.

(*C*) When an insulated body of water is permitted to evaporate freely in the air, it assumes the temperature of adiabatic saturation of that air and is unaffected by convection—i. e., the true wet-bulb temperature of air is identical with its temperature of adiabatic saturation.

From these three fundamental principles there may be deduced a fourth:

(*D*) The true wet-bulb temperature of the air depends entirely on the total of the sensible and the latent heat in the air, and is independent of their relative proportions. In other words, the wet-bulb temperature of the air is constant, providing the total heat of the air is constant.

APPLICATION OF THE EVAPORATION CALORIMETER TO THE DETERMINATION OF THE SPECIFIC HEAT OF AIR

In consequence of the psychrometric principles A, B and C, the moisture content of air from accurate psychrometric readings may be easily computed, provided the required temperature is known, as well as the density relations in a mixture of pure air and saturated water vapor, and also the exact latent heat of water vapor, and the specific heat of air and of water vapor at any temperature.

Recent research into the properties of water vapor has fully established its properties to a great degree of exactness, with the possible exception of the specific heat, which is of minor importance in psychrometric calculations. The author, however, was surprised to find upon investigation that the usual value assigned to the specific heat of air was unquestionably incorrect, since it had been definitely proved to be variable, and not a constant as assumed by Regnault. Moreover, recent investigators conducting their experiments with modern apparatus, supposedly with extreme accuracy, differed from each other by more than 3%, and from the generally accepted value of Regnault by more than 2%. Therefore, in order to use a rational formula in the construction of accurate psychrometric charts and tables, it becomes necessary to determine the specific heat of air to a much greater degree of accuracy than is known at present.

(At the time of this writing, the author stated, he was not prepared to give any definite data with regard to such determinations, but presented a method of employing the evaporation calorimeter which apparently affords great accuracy and upon which greater reliance can be placed than upon previous methods.)

DERIVATION OF A RATIONAL PSYCHROMETRIC FORMULA

In considering the interchanges of heat occurring in psychrometric phenomena, it is essential to consider primarily the relative weights of dry air and of water vapor, rather than the usual density-temperature relationship—that is, it is necessary to express moisture content as weight of water vapor per pound of pure air, rather than as weight of water vapor per cubic foot of space. Moreover, this relationship is much more adaptable to all of the usual calculations in air conditioning and in meteorology. The author, accordingly, has constructed all his formulæ and psychrometric charts upon this basis. In the deduction of the formulæ and in the construction of the accompanying charts, the following fundamental data were employed:

a Standard barometric pressure = 29.92 in. mercury = 14.6963 lb. per sq. in. = 2116.3 lb. per sq. ft.

b Absolute temperature = t + 459.62° F.

c B. T. U. = $\dfrac{\text{heat required to raise 1 lb. of water from } 32° \text{ to } 212°}{180}$

d Mechanical equivalent of heat = 777.52 ft.-lb.

e Specific volume of air = weight of 1 cu. ft. of pure air at 32° F. and 29.92 in. barometric pressure = 0.080728 lb. per cu. ft. Therefore $\dfrac{pv}{T} = 53.35$.

f Instantaneous specific heat of air $C_{pa} = 0.24112 + 0.000009\, t°$ F.

g Vapor pressure, Holborn and Henning's modification of the Theisen formula $(t + 495.6) \log \dfrac{p}{14.70} = 5.409\,(t - 212) - 3.71 \times 10^{-10}$ $[(689-t)^4 - (477)^4]$, as calculated in tables of Marks and Davis (1909).

h Specific volume of steam as calculated in steam tables of Marks and Davis (1909).

i Latent heat of water vapor.
$r = 141.124\,(689 - t)\ 0.31249$ (t = deg. F.).
$r = 109.16 - 0.56$ deg. F.
(approximately between 40° and 150° F.).

j Instantaneous specific heat of water vapor (approximately)
$C_{ps} = 0.4423 + 0.00018\, t°$ F.

k Specific weight of water vapor at saturation for any pressure and temperature.

$$S = \frac{\text{specific volume of air}}{\text{specific volume of steam}}$$

With respect to the reliability of these data, those on the latent heat of steam may be accepted as absolute within 0.1%, since the agreement of recent investigators seems to have established the present values beyond question. Strange to say, however, the specific heat of air, as already pointed out, has not been established with accuracy within 2%.

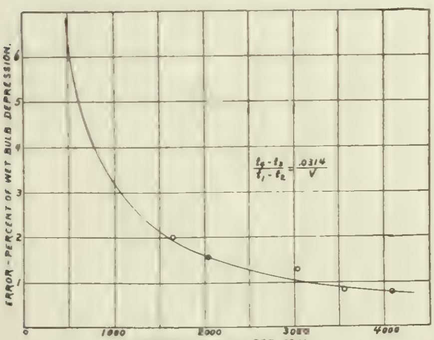

FIG 5—RADIATION ERROR IN WET BULB OF SLING PSYCHROMETER

Regnault gives it as a constant, Cp = 0.2375, and this value has been generally accepted. However, Holborn and Henning, whose valuable determinations in steam are well known, have demonstrated it to be a variable. For nitrogen they give a value $C\,(o - t) = 0.2350 + 0.000019\, t$ (*t* in deg. Cent.), a straight-line relationship, although for superheated vapors they find equations of a higher degree. The plot of their values for *C* for nitrogen lacks considerable uniformity. So far as the points given are concerned, they do not seem to warrant assuming a straight-line relationship. Their points would seem to indicate rather a curve with considerably greater values at lower temperatures than given by their line. If their values were accepted at atmospheric temperatures we would have a specific heat for air considerably lower than that given by Regnault, while psychrometric evi-

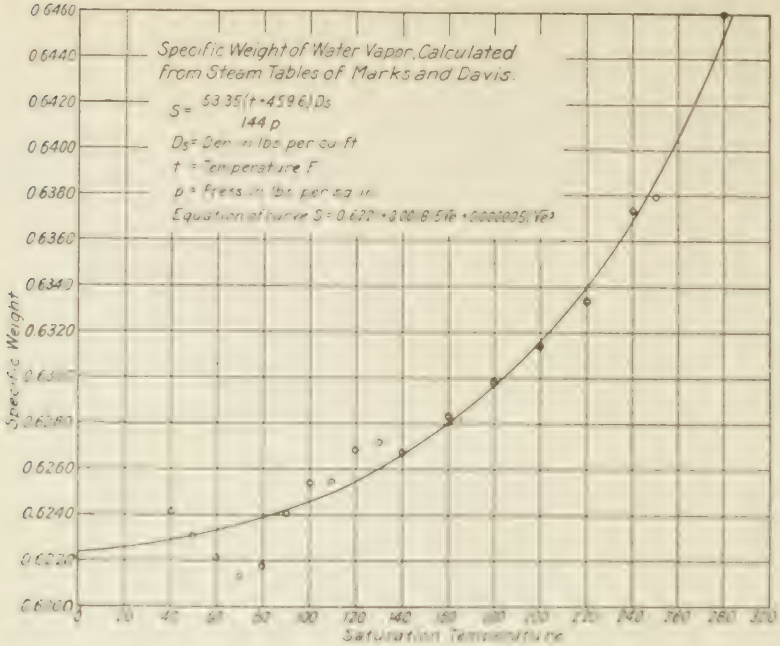

FIG. [illegible]. SPECIFIC WEIGHT OF WATER VAPOR

dence seems to indicate that it should be considerably higher at such temperatures. The most reliable of recent determinations would seem to be that of W. F. G. Swann. In his paper he points out a defect in the method of Regnault which would account for the latter's value being too low. The values given by Swann have therefore been adopted in this paper; although they appear still to require confirmation, since there would seem to be considerable opportunity for error in the method of air measurement used in his experiments.

The psychrometric charts, Figs. 1 and 2, are constructed accurately from the foregoing data. Fig. 2 exhibits all psychrometric relationships, between the temperatures of 20° and 380°, and saturation temperatures up to 143°. Fig. 1 gives the same values between temperatures 20° and 110° and saturation temperatures to 95°. These charts are here shown to a greatly reduced scale. In its original form, Fig. 1 permits the reading of both the wet- and dry-bulb temperatures to an accuracy of 0.1° and of the moisture weight per pound of air to 0.2 grains. All calculations have been made with accuracy to five significant figures by means of a Thatcher slide rule.

(In the complete paper the author here gives the formulæ from which his psychrometric charts were plotted.)

The need of an accurate rational psychrometric formula for vapor pressures using modern data is therefore apparent. The required values could be obtained indirectly from the formula already given, but computation is facilitated by another derivation giving directly the vapor pressure e.

(The author here shows the steps taken in deducing his rational psychrometric formula.)

$$e = e' - \frac{(P-e')\ (t-t')}{2800 - 1.3\,t'} \ldots\ldots [3]$$

in which

e = vapor pressure of saturated water vapor.

e' = vapor pressure at the dry-bulb temperature.

P = barometric pressure.

t = temperature of the dry bulb.

t' = temperature of the wet bulb.

This formula will give values of e for all wet- and dry-bulb temperatures and all barometric pressures with an error of less than 0.5%.

This equation should be used where the true wet-bulb temperature is obtained as in the aspiration psychrometer. With the sling psychrometer a correction must be made for the error in depression due to radiation and stem correction. This is inversely proportional to the velocity. It is also, of course, greatly affected by the conditions of exposure—i. e., whether it is surrounded on all four sides by bodies at the temperature of the dry bulb, or only partly by bodies of that or a different temperature. The effect of radiation outside of an enclosure may be assumed to be approximately one-half of that within an enclosure.

A sling psychrometer 15 in. in length is ordinarily revolved between 150 and 225 R. P. M., giving a velocity between 1200 and 1800 ft. per min. This will give a radiation error of 2.6 to 1.75% within an enclosure, and 1.3 to 0.9% without an enclosure. Hence an average radiation error of 1.6% of the wet-bulb depression may be arbitrarily assumed. The wet-bulb depression given by the sling psychrometer may be corrected by this amount to give the true depression, which may be used in the foregoing psychrometric formula, or the formula itself may be modified to allow for this error.

If this formula is corrected for 1.6% radiation error

$$e = e' - \frac{(P - e')(t - t')}{2755 - 1.28\,t'} \quad \ldots\ldots [4]$$

for the sling psychrometer.

Using the true wet-bulb depression in formula [3], letting e_2 be the vapor pressure corresponding to saturation at the dry-bulb temperature t

$$R = \frac{e}{e_2} = \frac{e'}{e^2} = \frac{(P - e')(t - t')}{(2800 - 1.3\,t)\,e_2} \quad \ldots [5]$$

for the per cent. of relative humidity.

Let W be the grains of moisture per cubic foot at any vapor pressure e, and W_2 grains per cubic foot at e_2; then

$$W = (RW_2) = \frac{W_2}{e_2}\left[e' - \frac{(P - e')(t - t')}{2800 - 1.3\,t'}\right] \quad \ldots\ldots\ldots\ldots [6]$$

also

$$W = \left(\frac{460 + t'}{460 + t}\right) W_1 \qquad W_1 \ldots\ldots\ldots\ldots\ldots\ldots [7]$$

where W is the grains of moisture per cubic foot, corresponding to the dew point at vapor pressure e.

EFFECT OF CHANGE IN BAROMETRIC PRESSURE

Suppose that air in which the vapor pressure is e_0 is compressed from a barometric pressure P_0 to a barometric pressure P, then the partial pressure of both the air and the vapor are increased proportionally and $e = \frac{e_0 P}{P_0}$.

The temperature corresponding to saturation at e is the temperature of the dew point at pressure P.

The per cent. of isothermal saturation becomes

$$R = \frac{e}{e_2} = \frac{e_0\, P}{e_2\, P_0} = \frac{R_0\, P}{P_0} \quad \ldots [8]$$

where e_2 is the saturated vapor pressure corresponding to the dry-bulb temperature t.

TOTAL HEAT CURVE

This curve shows the sensible heat in the air above a base temperature of 0° F., plus the latent heat contained in the water vapor at saturation, but not including the heat of the liquid. Since the wet-bulb temperature, or adiabatic lines contain all points having the same total heat (neglecting heat of liquid), the curve serves to determine the total heat in the air under any and all conditions represented by the chart. This is of great convenience in calculating refrigeration required to cool and de-humidify air. For example, suppose it is required to find the refrigeration necessary to cool 1 lb. of air containing 98 grains of

moisture and having a dry-bulb temperature of 95°, to a final temperature of 40° saturated. We find from the chart that the wet-bulb temperature is 75°. The total heat corresponding to a saturation temperature of 75° is 37.8 B. T. U., while the total heat at 40° is 15.3 B. T. U. The difference, 22.5 B. T. U., is the refrigeration required per pound of air.

Modern Design in Hospital Heating

(Concluded from November Issue)

"A type of heating system that is gaining much favor in large institutions as its advantages are becoming better known is the hot-water heating by forced circulation. By this is meant a system of hot-water heating in which a circulation is induced by means of a pump placed in the circuit of the mains, the water being heated by either exhaust or live steam, or by both. The advantages of this system are economy in steam consumption, ease of control, the maintenance of a constant temperature in the wards, and the ability to run the mains anywhere, regardless of the grades, thereby making possible the location of the power house at a desirable point, which is often not possible with a wholly steam system unless pumps or other devices are installed to return the water of condensation to the boilers or expensive pipe tunnels are built. Some of the disadvantages of this system are that it is necessary to have an independent steam system, as steam is required for other purposes in nearly all hospital buildings; that it requires a greater amount of radiation than a steam system and a consequent greater cost of installation; that it requires greater engineering ability or knowledge of design; and that it must be installed in a more careful and better manner than the usual type of steam systems. One of the great advantages and one that should not be overlooked, is the ability to control the temperature in the buildings by controlling the temperature of the water and the flow at the power house, besides the individual control of the radiators or coils. That this means much will be conceded when we consider the great variation in temperatures to which we who live in the East are subjected.

"In the New England States, for example, the temperature varies during the heating season from zero to 50°, and even more. As sufficient radiation must be installed to heat the rooms to 70° in zero weather, and as the average temperature for the heating season in New England is approximately 35° F., with a steam system of 100% more steam is used for heating than is actually required. If proper attention could be given and the radiation shut off when the temperature gets above 70°, this would not occur, but, unfortunately, this is not possible where there are a great many radiators or coils, and, besides, it is much easier to open a window and let the surplus heat escape.

"In some of the better class of hospital buildings, thermostatic valves are installed on the heat sources, which regulate the temperature of the building by regulation of the supply of steam to the radiation. Such devices are not only an expense to install, but are often found troublesome to maintain. Their installation the writer would recommend only to the better class of buildings and large wards and clinics where first cost is not to be considered. It may be claimed that it is possible to obtain a degree of regulation with steam by varying the pressure, but, even so, the best that can be obtained by such a method is by the use of high-pressure steam direct from the boilers, which is not good practice.

"A hot-water system is especially adapted to the heating of many widely separated buildings. Where ventilation or rapid air changes are required, fans supplying fresh air or exhausting

vitiated air are driven by electric motors. The hot water for all domestic purposes, also for the heating system, is heated at the central plant, and all apparatus centralized in the power house.

COMBINATION FORCED HOT WATER AND STEAM HEATING SYSTEM FOR A CANADIAN HOSPITAL

"A recent design for a large system of hospital heating and ventilating in the Dominion of Canada, where extreme temperatures had to be considered, may be referred to. After months of very careful study a combination system was adopted—namely, a forced hot-water system for all direct heating and a steam system for all tempering coils. Practically every room in the group of a dozen or more buildings is to be warmed by direct radiation. Tempered air will be introduced to all large wards and operating rooms and such other rooms as require rapid air changes. The ventilation will be entirely independent of the heating system and will be largely by exhaust fans on the roofs controlled by electric motors.

"The writer thoroughly believes in natural ventilation as far as possible. There are but very few days during the heating season that the well-trained nurse will not have the windows partly open to admit the health-giving fresh air just as it is provided by the Creator. At such times, the direct hot-water heat will probably care for the temperature of the rooms and the tempered air will not be required. Therefore, the fans introducing this air can be shut down and the expense of operation saved.

"I have often found entire systems where the wards were wholly dependent upon the introduction of air by fans or under pressure, where, owing to the great expense of operation, the same are not used or only partly so, and, therefore, no air is admitted to the rooms if doors and windows are closed, except what enters by wall or window leakage. In designing the plenum chambers and ducts, in this instance, they are so arranged as to introduce constantly tempered air by gravity, should the fans be closed; also, the system of ventilation will be open upon the same general plan by the introduction of aspirating coils either in the flues themselves or at the point of assembly on the roof. In this way, while we shall be able constantly to care for our room temperatures by direct radiation, we shall also have a natural gravity ventilating system that will give us from two to three changes of air per hour, even though the exhaust fans be closed down. This is perhaps the first combination hot-water and steam system of this nature applied to hospital practice, and, no doubt, will be watched with a great deal of interest. For a largely scattered institution located in a cold section of the country, what is now being planned for this modern hospital will, it is thought, prove the simplest, most economical and satisfactory of all systems."

Greenhouse Heating Charts

By John A. Payne

Attention is called to a transposition of the charts on this subject appearing in the last (November) issue. Chart 2 on page 39 and Chart 5 on page 32 should be transposed. The error will be obvious to anyone making use of the charts, but is here called to the attention of our readers, so that in filing these charts they may be given their proper place.

The Desired Increase of Power Obtained by Cutting Down the Back Pressure

It seems hard to realize that even today many manufacturers are throwing away their exhaust steam instead of utilizing it for heating or manufacturing purposes. Further cases have often arisen where a manufacturer needed more power to meet an increase of factory production and immediately purchased a new engine whereas the old one might have been made to do the work if its back pressure had been cut down.

A steam heating concern recently inspected a manufacturing plant where an increase of power was desired, as the factory output had somewhat increased. The manufacturers had about decided to put in a new engine, but, after having carefully considered the report of the engineers, concluded to put in a Webster vacuum system. It was found that with the vacuum system the back pressure was reduced sufficiently to enable the engine to perform the increased work.

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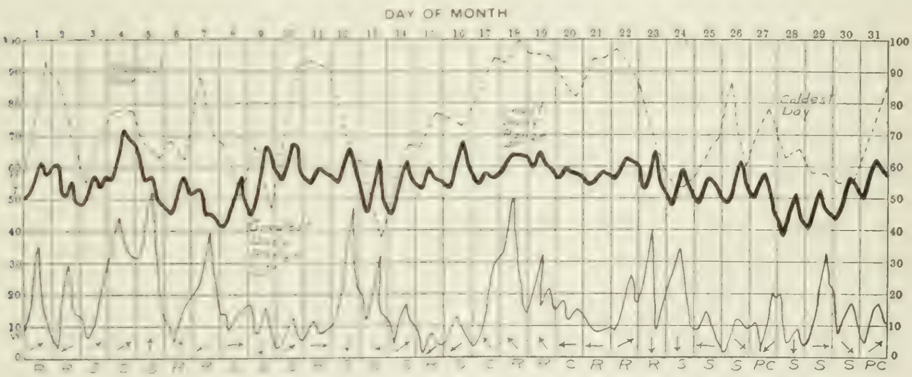
IT IS evident that the heating and medical professions have at last aroused themselves to a determination to discover the essence of good ventilation, or, at least, to learn the secret of what really constitutes "fresh" air. There is no denying the fact that the Government tests in this connection, coupled with recent theories of medical experts, have given a distinct jolt to those who felt that practically the last word had been said as to the character of the atmosphere. At the same time the new attitude towards ventilation has done little to clarify the situation as far as actual practice is concerned. It is easy to propose schemes that will serve very well as temporary expedients, but which are far too troublesome or unwieldy for continuous use. That is the present difficulty in the way of the adoption of most of the new theories regarding fresh air. In other words, the method whereby artificially warmed air is to be given precisely the same characteristics as outdoor air at the same temperature and humidity has yet to be worked out for adaptation to a mechanical heating and ventilating system.

The first steps in the important investigation about to be undertaken will be to identify this quality possessed by "fresh" air, which, it is claimed, is destroyed in passing through a modern heating system. The next step will be an effort to devise a mechanical arrangement of the ventilating apparatus best calculated to preserve the "freshness" of the air. While the details of the forthcoming investigations are not yet ready for publication, it may be said that influential members of both the medical and heating professions are coöperating enthusiastically on the project, and in one city have already secured facilities through the local officials for making the most ambitious ventilation tests ever undertaken in this country.

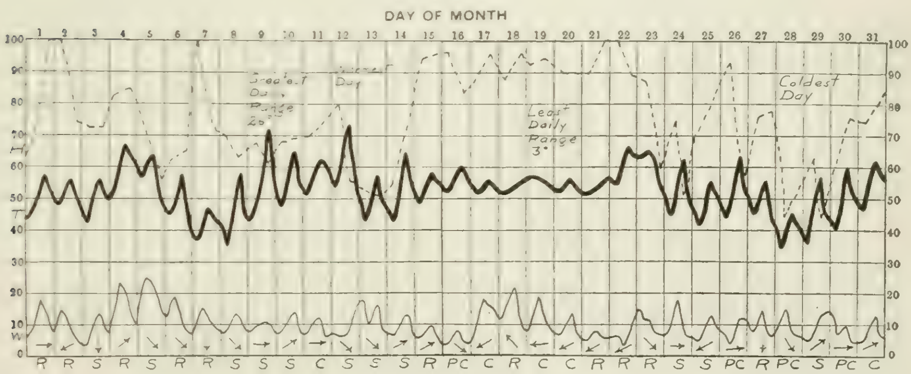
WHEN the matter of frequent temperature fluctuations was proposed as one of the solutions of the problem of good ventilation, the opinoin was expressed that it would be an easy matter to adjust the dampers in a hot blast or other indirect heating system so that currents of warm and, at least, mild air would be supplied during alternate intervals. The logic of this idea has recently been developed from the theory that human beings are most healthy when living an outdoor life. There they are subjected to continuous and often violent temperature fluctuations in the surrounding air, due partly to actual changes in the air temperature itself and partly to the cooling effects of the wind. Therefore, runs the argument, let us follow Nature and fluctuate our indoor temperatures.

The Weather for October, 1911

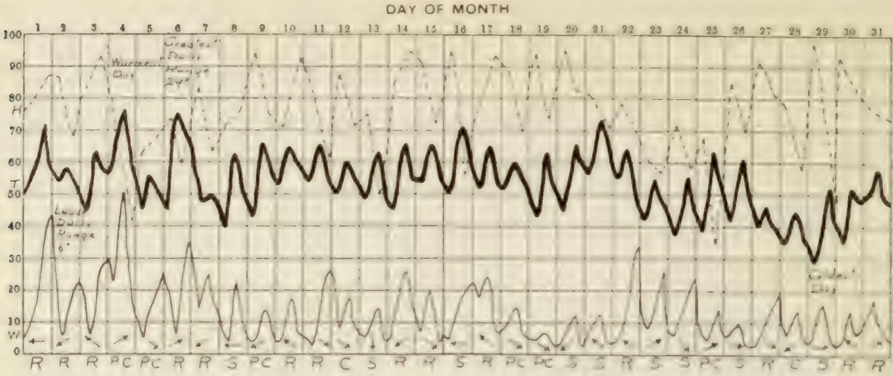
	New York	Boston	Pittsburg	Chicago	St. Louis
Highest temperature, degrees F........	72	73	77	79	88
Date of highest temperature...........	4	12	4	3	3
Lowest temperature, degrees F........	39	34	29	32	35
Date of lowest temperature...........	28	28	29	27	27
Greatest daily range, degrees F.........	23	26	29	25	27
Date of greatest daily range...........	9	9	6	6	6
Least daily range, degrees F...........	4	3	6	4	5
Date of least daily range..............	18	19	2	8	20
Mean temp. for month, degrees F......	56	53	54	53	57
Normal mean temp. for month, deg. F..	56	52	54.9	53.2	58
Total rainfall, inches.................	5.38	2.27	4.94	3.79	2.63
Total snowfall, inches................	0	0	0	0	0
Normal precipitation, this month, inches	3.71	3.86	2.36	2.55	2.41
Total wind movement, miles..........	11022	7023	6943	9507	7021
Average hourly wind velocity, miles....	14.8	9.4	9.3	12.8	9.4
Prevailing direction of wind...........	S.W.	N.W.	N.W.	West	N.E.
Number of clear days..................	8	11	9	7	9
Number of partly cloudy days.........	8	6	8	9	6
Number of cloudy days................	15	14	14	15	16
Number of days on which rain fell.....	20	11	14	17	10
Number of days on which snow fell....	0	0	0	0	0
Snow on ground at end of month, in....	0	0	0	0	0



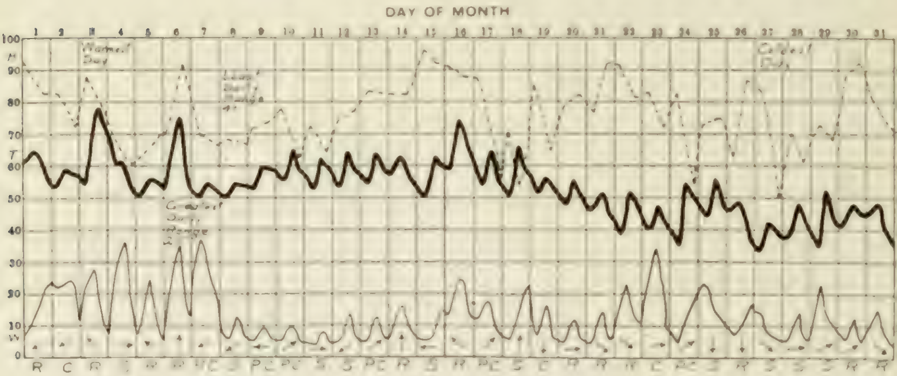
RECORD OF THE WEATHER IN NEW YORK FOR OCTOBER, 1911



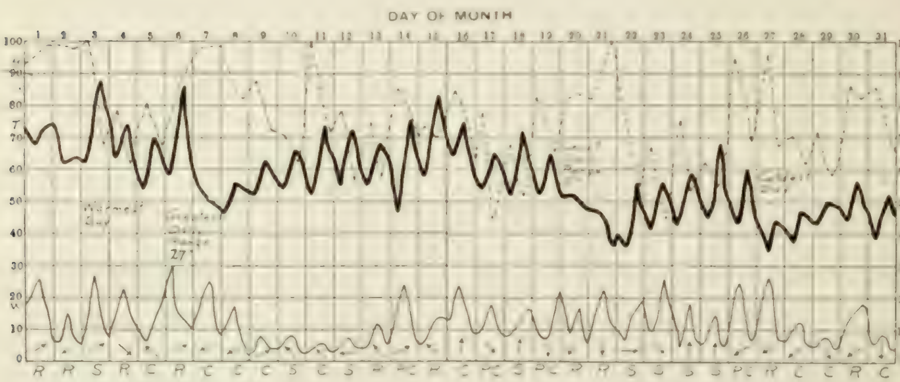
RECORD OF THE WEATHER IN BOSTON FOR OCTOBER, 1911



RECORD OF THE WEATHER IN PITTSBURG FOR OCTOBER, 1911



RECORD OF THE WEATHER IN CHICAGO FOR OCTOBER, 1911



RECORD OF THE WEATHER IN ST. LOUIS FOR OCTOBER, 1911

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A.M. and 8 P.M.

S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

CORRESPONDENCE

Peculiar Conditions in Steam Heating Plant

Editor HEATING AND VENTILATING MAGAZINE:

I give below a description of a peculiar condition existing in a direct steam heating system supplied from cast-iron sectional boilers of standard make and fed by means of an overhead steam main on a two-pipe system, supply mains being dripped at the present into a low return line, into which return risers are connected. Two boilers are used with the above system, each rated at about 6,000 sq. ft., while the system contains about 10,000 sq. ft. of direct radiation.

Trouble was first noted with the heating system when the same was placed in service at the beginning of the season, when the outside temperature was probably from 55° to 65° F. One boiler only was started up, and as soon as steam pressure in the same raised from 1½ to 2 lbs., the water was pushed entirely out of the gauge glass, apparently backing up in the return mains. This condition existed as long as the boiler was kept in service, i. e., for several days—whenever the steam pressure rose above 1½ lbs.

During this time a number of tests were made on the boiler and no difficulty was experienced in keeping the pressure even higher.

Thinking, perhaps, there was some defect with the boiler in use, the second boiler was cut in and the first boiler cut out, and the same conditions noted, i. e., steam pressure could be kept up with the greatest ease, and the water apparently left the boiler at least lower than the lowest gauge cock. During this time, also, practically none of the radiators on the first floor or basement could be heated, although the radiation on the upper three floors was hot. The plant was then run with both of the boilers in service and the entire system heated throughout, the boiler water line remaining practically stationary.

While the two boilers were in service the temperature dropped very suddenly to about 18° to 20° F. and no difficulty was experienced in either heating the building or maintaining the steady water line during the cold period. After the cold period had passed off and the temperature had arisen to about 45° to 50°, one boiler was cut out and the conditions noted at the time of operation with boiler were repeated.

I am at quite a loss to understand why, with only one boiler in use and very moderate outside temperature, the system does not fill with steam and why the pressure on the boiler does not fall if the steam condenses in the system, which would seem to be the case if the boilers were very much too small for the job. As far as can be learned, all the piping throughout is of adequate size, and a number of gauge readings taken on the radiators throughout the building would indicate very little loss of pressure.

The above plant was designed with the idea that one boiler would heat the same in mild weather, but up to the present time this has not been accomplished. I would be very glad to know whether or not you have had similar cases called to your attention and what the explanation would be, as at the present time I can see no reason why one boiler should not do the work.

J. L. EISER.

Baltimore, Md., November, 1911.

The conditions surrounding this job are extremely puzzling, if the real cause is not known. A vigorous draft and an intense fire account for the ability to show pressure on the boiler when one only is being used. Notwithstanding the show of pressure, one boiler is not able to carry the job under any weather conditions. Hence the water banks up in the system instead of returning to the boiler. To prove this, run one boiler with, at least, half of the radiation shut off. No doubt the job will then circulate properly.

Ten Formulas for Radiation

Editor HEATING AND VENTILATING MAGAZINE.

I have been considerably interested in studying the "Ten Formulas for Radiation" which you give in the October number of THE HEATING AND VENTILATING MAGAZINE, and I have made a careful comparison of all of them, together with the formula which I use in my own practice, and have prepared the following table of the results:

Formula	C factor	W factor	G factor	R
W.E.L.	0.0056	0.092	0.34	86.6
1	0.0056	0.084	0.32	82.1
3	0.0050	0.050	0.50	106.5
5	0.0102	0.070	0.28	87.3
8	0.0060	0.090	0.45	106.2
9	0.0052	0.071	0.50	109.9
10	0.00545	0.075	0.30	77.1

In the above table all of the factors have been reduced from the data given in the article to a similar basis and all formulas have been reduced to the exact form of formula No. 3, and the amounts of radiation as given in the last column of the table have been figured therefrom.

Formula No. 9 was reduced to a steam

basis by dividing by 1.4, the ratio between the temperature differences between the heating medium in the radiators and the temperature of the room in the case of steam and water respectively $\frac{224 - 70}{180 - 70}$

The last four terms in formula No. 10 were omitted as the corresponding quantities were not considered in any other case. The amounts of radiation given in the table have been calculated for a room of 3,000 cu. ft. contents, 130 sq. ft. of net wall area and 170 sq. ft. of glass. In each case the wall has been considered to be 12 in. or 13 in. thick and the glass to be single thickness.

Except in the case of formulas 3, 8 and 9 there is very little variation in the results for the room in question, although in the case of a corner room there would be a different ratio in the results.

Formula No. 5 gives a close average result in the case of the room selected for comparison, but in the case of a corner room where the cubic contents was small and the glass area excessive, a resulting amount of radiation would be obtained which would be too small for the proper heating of the room, due to the fact that the C factor is large and the G factor small.

The large amounts of radiation obtained from 3, 8 and 9 are due to the excessive allowance made for the glass area.

Formulas 2, 4, 6 and 7, as given in the article, are evidently incorrect as they all give ridiculous results as can be readily seen by the most casual inspection.*

I should be glad to receive the correct formulas for these cases and shall be interested in any further data you may receive on this interesting subject.

William E. Leland.

San Francisco, Cal., November, 1911.

*These four formulas, it is found, were incorrectly printed in the committee's report, and the committee has been unable as yet to procure the data in their original form. It is hoped that the author of the formulas in question will be able to furnish the needed corrections.—Editor.

Ventilating Appliances on Chicago's Elevated Cars

Replying to a complaint that the ventilators on some of the elevated cars in Chicago were opened "backwards" instead of facing the wind, President B. I. Budd states that the cars in question are equipped with floor intakes—i. e., there are about six openings, each 2 in. square, through the floor. Underneath the car there are scoops which force the air into the car on the floor line and the foul air is exhausted through the ventilators at the top of the car.

This plan of ventilation is in accordance with the city ordinance, and since the cars have been equipped with these ventilators it has been necessary to open the deck sash in a trailing position. If opened the other way there would be no chance for the foul air to escape except when the doors were opened at stations.

Air Inlets on Street Cars Admit Dust

A correspondent of the Chicago *Tribune* has noted that in dry weather some of the street cars are filled with an unusual quantity of flying dust. He states that several times he has seen passengers go to the platform to relieve their lungs of the dust that was choking them. On investigation he has found that the dust did not come in through the open windows or open doors which were, in fact, operating as air outlets. He then noticed a cloud of dust pouring out of a ventilator under the long seats at the front of the car. An opening had been made in the floor of the car through which air was supposed to be sucked in by the motion of the car, and after entering was intended to pass out through ventilators at the top of the car. Answering the complaint, an official of the Chicago Railways Company states:

"The municipal code requires that all street cars be ventilated and it is provided that the air must be taken into the car at a point below the height of the heads of seated passengers. The cars on Grand avenue are equipped with ventilating devices in compliance with the code. An investigation will be made of the car referred to, with the object of ascertaining whether there is any defect in the intake."

Changing the Air in Assembly Rooms

Writing in the Chicago *Tribune*, under a department entitled "How to Keep Well," Dr. W. A. Evans states: "Last week at the Illinois Federation of Women's Clubs, the proceedings were interrupted about once every hour by the opening of the windows. While they were open the ladies stood up. After a few minutes the windows were closed and the exercises resumed.

"Ten minutes in that fresh air," comments Dr. Evans, "and those quickened minds were worth as much as any thirty minutes where minds are dulled and the air is stale.

"At the Infant Welfare Congress the same plan was pursued. Prof. Henderson would call for little periods of recess; there would be a little stirring around, a little quickening of circulation, and then back to concentration of mind.

"The scheme is physiologically and psychologically sound. Now, why can it not be followed in offices?

"The ventilation almost everywhere is bad. Most of it was put in on the old plan of uniformity of temperature and

freedom from air movement. So much was planned. Not through planning but through oversight the air is usually harmfully dry. At this day we know there is no efficiency of mind or body unless the temperature varies and unless the air moves around enough to make its movement felt.

"Why should it not be good judgment for the chief clerk to have the office force —or the foreman have his factory force —stand up for five minutes out of each hour while the windows are thrown open and the room blown out. The fifty-five minutes remaining would be used for greater gain than the sixty minutes of the hours which flow along without a break.

"Where it is possible, it would be better to add to this plan an equipment of fans to keep the air moving during the remaining fifty-five minutes.

"This plan would not be ideal. For one thing, the air would be too dry. But it would make a lot of bad situations a good deal better."

House Heating Boilers in New York State Must be Insured or Inspected

A provision of Chapter 451 of the New York State laws relative to the inspection of steam boilers by the State fire marshal is attracting much attention, as it is found to include heating plants as well as power boilers. The provision in question reads:

"The State fire marshal shall also cause to be inspected all boilers in buildings and all other places where same are used for the generating of steam, except where a certificate has been filed certifying that such boilers have been inspected by a duly authorized insurance company. A fee of $5 shall be charged the owner or lessee of each boiler inspected by the inspector of the office of the State fire marshal."

There are in the State about 1,700 insurance companies whose certificate State Marshal Thomas J. Ahearn will accept, and the agents of these see to it that the fire marshal does not have to make an examination, if they can help it. To insure a boiler does not cost much in excess of the fee that the fire marshal would exact if he had to make an inspection, therefore the owners of boilers are convinced of the economy in taking out a policy of insurance in the first instance.

Under authority vested in him Fire Marshal Ahearn has made an order that all boilers generating 10 lbs. pressure and over of steam are subject to inspection. It is not generally appreciated, however, that this applies to heating plants as well as power plants, and that residences, as well as factories, come under the order.

The fact that the certificate of the insurance companies will be accepted by the State fire marshal in lieu of an examination by one of his deputies is admitted to be greatly to the advantage of the insurance companies.

Current Heating and Ventilating Literature

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

CENTRAL STATIONS

Combination Heating and Generating Plant at Springfield, Ill. Illustrated description of a station furnishing electric energy for light and power, and low-pressure steam and hot-water systems for heating. 3000 w. Elec Wld—Sept 2, 1911. 20c.

FAN SYSTEM VS. DIRECT RADIATION

Fan System Versus Direct Radiation. Ira N. Evans. Power. Oct. 10, 1911. 6 figs. 7500 w. Shows the relative economy of each method when the physical conditions are favorable. 20c.

VACUUM HEATING

Vacuum Heating Systems. Charles L. Hubbard. Steam. Oct., 1911. 20 figs. 3700 w. 20c.

The First Authoritative Work on Central Station Heating

A notable book that will make its appearance the first of the year is entitled, "Notes on Central Station Heating," by Byron T. Gifford. Mr. Gifford is vice-president of the Central Station Engineering Co., of Chicago, and his extensive experience in the design and installation of district heating systems qualifies him to a marked degree to speak with authority on this subject. A portion of Mr. Gifford's matter appeared in serial form in THE HEATING AND VENTILATING MAGAZINE during the present year, but by far the larger part of his book is entirely new and is now for the first time published. The whole constitutes a review as well as an exhaustive data book on central station heating that ably fills a long-felt want in this important industry.

The work is being published by the Heating and Ventilating Magazine Co., 1123 Broadway, New York, and will be ready for delivery January 1, 1912. Orders are now being taken for delivery on that date, the price of the book being $4.00, postpaid.

Harrison's "Applied Heating and Ventilation"

A remarkable record for the sale of a high-grade work on heating and ventilation is reported by the New York Heating and Ventilation School, 1123 Broadway, New York, which states that, at the present rate of sales, the first edition of J. M. Harrison's "Applied Heating and Ventilation" will be entirely exhausted by the first of the year. This work, as is well-known, comprises the complete set of lesson sheets, with an additional number of charts used in the course of instruction in heating and ventilating engineering put out by this school. The demand for the book at the price at which it is sold, $10.00, testifies to the high character of the data it contains as well as to the demand on the part of the trade for practical information on the more important phases of steam, hot blast and forced hot water heating.

America's Alleged Heating Trust

A startling article appearing recently in a Chicago paper entitled, "Nation to Fight Heating Trust," has aroused much comment, as the article went on to state that the Department of Justice in Washington has practically completed an investigation of the vacuum heating companies in the country with the result that it has evidence regarding four which is deemed worthy of careful consideration. A later dispatch states that Robert L. Gifford, of Chicago, president of the Illinois Engineering Company, went to Washington to investigate the basis for the story in which he is alleged to have furnished the information upon which the government would proceed. He was assured by officials of the Department of Justice, the dispatch continues, that no evidence had been obtained against the vacuum heating companies and that the statement to the contrary was without foundation.

The story went on to say that the four companies involved were Warren Webster & Co., Camden, N. J.; the Automatic Heating Company, New York; the Consolidated Engineering Co., Chicago, and the Illinois Engineering Company, Chicago, and continues:

"In the five years they are alleged to have been coöperating it is estimated by the government investigators they have collected $4,830,000 in license fees or royalties in less than thirty of the larger cities of the country.

"Because of these large royalties and their suits against smaller concerns, the government is interested in knowing whether they have been using their extraordinary profits in an effort to restrain trade.

FOUR HAVE COMMON AGENT?

"The federal agents report that this quartet has a common secretary or agent who receives a report of all sales and gives advice on charges to be made. His name is Robert McGantis, with an office on the fifth floor of the Royal Insurance building in Chicago.

"One of the officers of the four companies, said to be Robert L. Gifford, president of the Illinois Engineering Company, is reported to have given all of the details of the system employed. He is also said to have asserted that the companies have decided to quit their coöperative plan.

"Roughly speaking, vacuum heating systems provide for sucking the air out of steam coils and therefore pulling the steam through instead of the old system of forcing the steam through the pipes. The principal part of the vacuum systems are patented valves. These four companies are said to issue a license, which they represent includes their expert engineering service, to use the patents. Then the system for a particular building is sold at a good profit, which consists principally of valves. No piping or radiators is included.

"After each member of the informal association makes a price for his system those figures are said to be sent to Mr. Gantis, who suggests the royalty fee which should be added. A certain percentage, varying from 25% to 33% of the royalties is left with Mr. McGantis, and from this fund costs of suits against smaller concerns are said to be paid. Nearly all of these suits relate to patents.

"The government is said to have the names of a few buildings on which the royalties paid were as high as $20,000, and in a number of structures the tax was between $5,000 and $10,000. One in the latter class is said to have been the new Northwestern Railroad station in Chicago.

"In this structure it is estimated that a reasonable selling price for the devices was possibly $1,000 or $1,500, but the license fee brought the aggregate to $7,000 or more.

ESTIMATES ON LICENSE COST

"The government estimate of the approximate license fees paid in the large cities in the last four or five years is as follows:

New York	$960,000
Philadelphia	275,000
Washington, D. C.	95,000
Baltimore	175,000
Pittsburgh	580,000
Boston	315,000
Cincinnati	125,000
Cleveland	145,000
Buffalo	85,000
Chicago	840,000
Detroit	70,000
Minneapolis and St. Paul	170,000
St. Louis	280,000
New Orleans	80,000
Denver	105,000

San Francisco	95,000
Los Angeles	120,000
Numerous smaller cities	315,000
Total	$4,830,000

USUAL RATE OF ROYALTIES

"These figures do not include the prices charged for the heating appliances installed. The rate of royalty usually followed is 10 cents a square foot of radiation on all jobs of less than 10,000 sq. ft., 8 cents on jobs between 10,000 and 20,000 sq. ft. and 7 cents on jobs involving more than 20,000 sq. ft.

"The inquiry was started, it is said, because of an experience of the federal government itself in the construction of the naval training station in Chicago. The government always declines to pay for royalties on anything, and did in this case. The Noel Construction Company, of Baltimore, had the general contract and a naval engineer named McKay was on the ground looking after the government's interest.

"The vacuum heating system purchased was the Van Auken, owned by the Consolidated Engineering Company, of Chicago, of which Byron E. Van Auken is secretary. McKay is said to have discovered that valves in one building cost $5, while the same valves in another building cost $10, and he wanted to know the reason for the wide difference in price.

"The leaders in the vacuum heating business are said to be James E. Hegg, president of the Automatic company; Warren Webster, of the company bearing his name, and Byron E. Van Auken. The Illinois Engineering Company is credited with disliking the methods of the others, but for self-protection is said to have been forced to enter into the coöperation."

American Society of Mechanical Engineers

A forward movement of the American Society of Mechanical Engineers in an effort to bring the engineering profession into a share of the prominence and leadership in public affairs now largely held by lawyers and financiers, was announced as the keynote of its annual meeting in New York, December 5-8, 1911. For this purpose more than forty committees were appointed, each one of which is to investigate some particular industry and thus permit the society to serve it for the betterment of industrial and social conditions therein.

The programme for the annual meeting included the following papers:

"Tests of Large Boilers at the Detroit Edison Company," by D. S. Jacobus.

"Strain Measurements of Some Steam Boilers Under Hydrostatic Pressures," by James E. Howard.

"Rational Psychrometric Formulæ: Their Relation to the Problems of Meteorology and of Air Conditioning," by W. H. Carrier.

"Some Experiences with the Pitot Tube on High and Low Air Velocities," by Frank H. Kneeland.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Dates Fixed for Annual Meeting

The dates for the annual meeting of The American Society of Heating and Ventilating Engineers have been definitely fixed for January 23, 24 and 25, 1912. In addition to the membership ballot sent out October 31, it is anticipated that another ballot will be issued in time to be canvassed before the annual meeting.

New York Chapter

An attendance of 20 members and guests was registered at the November meeting of the New York Chapter, which was held in the Engineering Societies building, November 14. The proceedings included a discussion of the "Aims and Purposes of the Chapter"; a short paper by Thomas Barwick, on "By Advice of Our Consulting Engineer," dealing with the relative efficiency of a city bureau and a private engineer with regard to work on city buildings; and a talk on "Ventilation of Moving Picture Shows," by Secretary Joseph Graham.

President W. M. Mackay appointed the following committee to act in connection with the parent body to arrange for the entertainment at the annual meeting: D. D. Kimball, M. F. Thomas, H. J. Barron, F. G. McCann and Thomas Barwick.

A proposal to make the meeting night the third Tuesday in the month, instead of the second, was laid over until the December meeting.

National District Heating Association

The executive committee of the National District Heating Association met in Detroit, Mich., November 8 and 9, to fix the time and place for the fourth annual convention of that association, and to arrange the program for that convention. The committee unanimously decided on Detroit, and fixed the dates, June 25, 26 and 27, 1912.

Papers upon the following subjects will be presented at this convention:

Depreciation in underground distribution systems.

Operation of turbines and reciprocating engines in connection with steam heating work.

Description of a combined steam heat-

ing, ice making and electric power system.

Radiation tests.

Heat losses in steam distributing systems.

Description of a large hot-water heating system.

Quality of steam supply as affected by use of superheat at station.

De-centralized heating plants.

Relative economics of one- and two-pipe heating systems in buildings.

Sources of trouble in customer's installations.

Thermo-dynamic economy of combined power and heating systems.

Different systems of underground construction.

One paper to be presented by the Cleveland Electric Illuminating Company, subject not yet announced.

The membership shows a substantial increase since the convention held in Pittsburg and the interest and enthusiasm in the work manifest.

Boiler Exhibit Showing Connection and Piping for Nine Different Heating Systems

The accompanying illustration shows a novel and interesting display of heating goods on exhibit in the New York showrooms of the Pierce, Butler & Pierce Mfg. Co., at 279 Fourth avenue. Nine different heating systems are here on view, all properly connected, giving a graphic illustration of the different methods and making it easy to compare them. The idea was suggested by James A. Harding, who is in charge of the salesroom, and, as carried out, have proven of much interest to the prospective owners as well as to engineers and contractors. The heating systems comprised in the exhibit are one-pipe steam, with direct and indirect radiators; down-feed, interchangeable steam and hot-water system; twopipe, upfeed, hot-water system; one or twopipe vapor or vacuum systems, with fractional radiator valves; and a hot-water heating system, with generator to accelerate the flow of the water.

The principal apparatus included in the display are the company's Modern boilers of varying capacities, Louraine radiators and Pierce wall radiators; also the company's Climax generator, for accelerating the flow in hot-water heating systems. The second boiler from the end, on the left, is connected to the system described as an overhead, down-feed, for either steam or hot water. This system is designed to be used with hot water in mild weather. For use with steam, the water is drawn off down to

EXHIBIT OF HEATING GOODS, SHOWING NINE DIFFERENT HEATING SYSTEMS

the water line in a steam boiler. The expansion tank, connecting with the riser at the right, is not shown. The main from this point is carried over and connected with the radiator at the top and bottom, permitting its use with either system. It will be noticed that with this arrangement the radiators each require two valves.

Pierce, Butler & Pierce Mfg. Co. is having the photograph of this display lithographed in large size and will shortly send out the hanger to the trade.

Bristol's Frictionless Ink Type Recording Instrument

To meet the demand for a frictionless ink type of recording instrument to parallel the smoked chart recorder as near as possible in fundamental simplicity and to accurately record fractions of milli volts and adapted for use as a recording electric pyrometer, the instrument illustrated herewith has been developed and placed upon the market by The Bristol Company, Waterbury, Conn.

These instruments have been tested out in practical service for two years past and are the result of several years of study and experience with an original* patented design of a frictionless ink recorder using a hinged electrical movement carrying a retaining receptacle for marking fluid which extends over the path of the recording tip and is provided

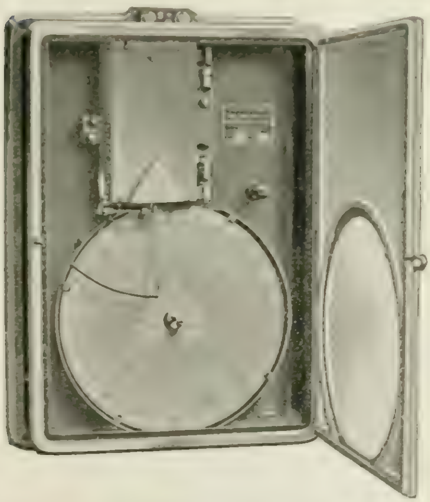


FIG. 1—INTERIOR VIEW OF BRISTOL RECORDER

with means for periodically making contact with the source of marking fluid and the chart.

Fig. 1 is an interior view showing the galvanometer movement case hinged to the back of the instrument and carrying the inking pad in front of the recording arm. Fig. 2 shows the sensitive electrical movement swung to one side for convenience in removing the record and inserting a fresh chart. A capillary gold tube open at both ends is carried at the end of the recording arm at right-angles to the surface of the chart. The inking pad is suspended from the case of the

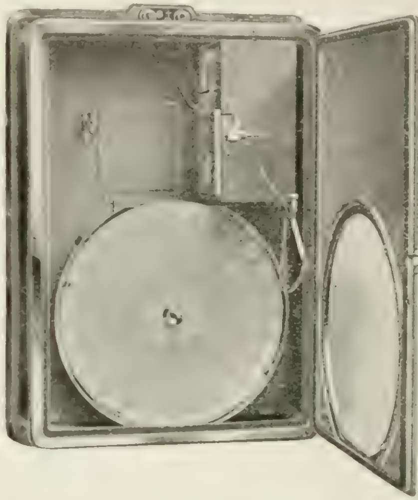


FIG. 2—VIEW OF INTERIOR WITH ELECTRICAL MOVEMENT SWUNG TO ONE SIDE

electrical movement and is curved to correspond with the arc covered by the motion of the end of the recording arm.

When the movement is swung back into its operating position, as shown in Fig. 1, the recording arm can swing free, accommodating itself to the position corresponding to the delicate current which is to be measured. The clock which revolves the chart at the desired speed also automatically presses the inking pad toward the chart every ten seconds, bringing one end of the capillary tube into contact with the chart and the opposite end simultaneously into contact with the inking pad. A fine dot of ink is left on the chart and the capillary tube is replenished with ink from the pad. The recorder thus carries a constant supply of ink, and its balance, which is very important, is always maintained. The electrical movements used in these recorders are made especially for the purpose by the Weston Electrical Instrument Co.

Although the most important applications of these recording instruments have been for pyrometers, they have also been used for electrolytic research, recording voltmeters, and recording shunt ammeters.

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*Patented by Wm. H. Bristol, April 13, 1909.

American Institute of Chemical Engineers

The programme for the forthcoming annual meeting of the American Institute of Chemical Engineers, which will be held at the New Willard Hotel, Washington, D. C., December 20-23, 1911, includes papers on the following topics:

"Combustion of Pulverized Coal," by L. S. Hughes.

Symposium on the United States Patent System, in which the principal speakers will be E. B. Moore, patent commissioner, U. S. Patent Office; Edward T. Fenwick, Walter D. Edmonds and R. N. Kenyon.

Advertisers' Index

TRADE AND MISCELLANEOUS NOTES

Coming Events

Second Tuesday in Each Month—Meeting of the New York Chapter, American Society of Heating and Ventilating Engineers, Engineering Societies Building, 29 West 39th street, New York.

December 13-14, 1911.—Annual meeting of the National Association of Brass Manufacturers in New York. Headquarters at the Hotel Astor, Broadway and 44th street.

December 20-22, 1911—Fourth annual meeting of the American Institute of Chemical Engineers in Washington, D. C. Headquarters at the New Willard Hotel.

January 23-25, 1912—Annual meeting of The American Society of Heating and Ventilating Engineers in New York. Headquarters at the Engineering Societies Building, 29 West 39th street.

Miscellaneous Notes

Baltimore, Md.—The new high-pressure pumping station on South street is so far advanced that the city has asked for bids for the installation of the heating and lighting plant. This idea was advanced some months ago by President John Hubert, of the Second Branch Council, who figures that by this arrangement the city can save more than $5000 per annum on its bills for heating and lighting. It will cost about $70,000 to install these plants, which include electric generators, steam engines and many electrical appliances. With the completion of this pumping station, the new highwater service will be put into use. It has been in the course of construction for several years and when finished the total cost will be about $800,000.

Freeport, Ill.—A movement is on foot to organize a company to put in a central heating plant for the business section of the city.

Buhl, Minn.—The council has instructed the city attorney to prepare an ordinance regulating the rates which are to be charged for heatin~ service from the new municipal lighting system being put in at a cost of $20,000. Besides the

old and new schoolhouses the heat will be used in a considerable portion of the residence section.

Pittsburg, Pa.—At a meeting of the executive committee of the Master Boiler Makers' Association held at the Fort Pitt Hotel October 28, it was unanimously decided to hold the sixth annual convention of this association in Pittsburg, May 14-17, 1912, with headquarters at the Fort Pitt Hotel.

New Ulm, Minn.—According to recent reports, it is likely that the project for a central heating plant to supply the business section of the city, in connection with the municipal electric light and water plant, will be abandoned.

Milwaukee, Wis.—C. A. Crownhart, president of the Milwaukee Industrial Commission, reports that the commission is working in complete harmony with factory owners in working out the problems of better conditions in the factories. All improved systems of heating or ventilation suggested by the commission have been given a thorough test and proven good, and, as such, are adopted without protest by the factory owners.

Cottonwood Falls, Kan.—Being unable to heat the Chase county high-school buildings with a sufficient degree of comfort by using natural gas in their furnaces, the high-school trustees ordered the school closed until a different mode of heating could be put in. For several years the school has been using gas for heating purposes from the Elmdale fields, six miles west of this city.

Ypsilanti, Mich.—The proposition to bond the school district for $75,000 for a new school and a central heating plant was defeated at a special election.

Houghton, Mich.—A new Scharf smoke-consuming device has been attached to the furnace of the Dee central plant. The device has for its principle of operation the application of a jet of steam to the surface of the fire in the furnace when the doors are opened and fresh coal is being put on. The opening of the doors moves a series of levers which actuate a thrust pot, which in turn opens two draft doors in the fire doors of the furnace and at the same time turns on the steam jets. The steam, in combination with the air admitted through the draft doors, forms a gas which aids in the combustion of the smoke and the fine particles of coal arising from the fresh coal. After the furnace doors are closed the draft doors remain open and the steam jets continue for about three minutes, the time required for gravity to lower the plunger in the thrust pot and stop the operation.

Gloversville, N. Y.—The local city officials report a novel use of a steam roller to supply steam for the city hall when an important part of the mechanism of a new boiler being installed in the city hall was not shipped, rendering it useless for service.

Peoria, Ill.—A remedy for the ineffectiveness of the new heating plant of the Washington school has been discovered in the lengthening of the smoke stack. Fifteen feet have been added to it with the effect that the stack now draws sufficiently for the boilers, and the building can be properly heated.

Boone, Ia.—The city council has voted to grant a franchise for a central hot-water heating station to the Boone Electric Company.

National Association of Brass Manufacturers will hold its annual meeting at the Hotel Astor, Wednesday and Thursday, December 13 and 14.

Newburyport, Mass.—Lester Dow, consulting engineer, of Salisbury, Mass., who was called in to ascertain the trouble with the heating plant of the new Currier school, found a large hole in the brick partition intended to separate the chimney flue from the hot-air ducts near the basement, preventing a proper draft and making it impossible to properly heat two or three of the rooms in the building.

Moberly, Mo.—A central heating plant is being discussed for Moberly.

Chicago, Ill.—At a dedicatory service held October 29, at the Thomas J. Waters School, Wilson and Campbell avenues, a memorial tablet to the memory of the late Thomas J. Waters, chief engineer of the board of education, who died February 25, 1909, was presented by Walter F. Caldwell, president of Local No. 143, International Union of Stationary Engineers, and was received on behalf of the board of education by the president, Dr. James B. McFatrich. The Illinois Chapter of the American Society of Heating and Ventilating Engineers was represented. Others present included a number of Mr. Waters' former associates in the Department of Education. Mr. Waters was a charter member of the American Society of Heating and Ventilating Enginers and served as a member of the council in 1895 and as vice-president in 1906.

Kalamazoo, Mich.—A proposed franchise for a central heating plant in Kalamazoo has been formally presented to the city council in favor of the Central Station Engineering Co., Chicago. The council already has a proposed franchise for the same purpose under consideration, introduced at the instance of the W. H. Schott Co., of Chicago. A committee of the city council has recently visited other cities in which central heating plants are in use, notably Kokomo, Indianapolis, Crawfordsville and Logansport, and returned favorably impressed with what it had seen. In Crawfordsville the party was shown through the plant by General Manager W. K. Martin. In describing the plant, Mr. Martin said: "We have found the hot-water system satisfactory, although, were we confronted with the problem of heating high buildings, I have no doubt steam would be used. We have six miles of mains running through the streets. The farthest point from the station reached by us is close to a mile away.

"We have established a flat rate largely because there has been no efficient hot-water meter devised. I would not say that the meter system is not the best. We start our plant the 15th of September, ordinarily, although this year we had no cause to get under way until the first part of October.

"Our plant was built by the Central Station Engineering Company and has never been changed except for an increase of boiler capacity, which we found necessary to take care of our customers.

"We secured our franchise from the city and in payment give free heat for the city buildings and city hospital. Our charge to the consumers is 17 cents per square foot of radiation.

"I will say, frankly, that I consider this charge too low and would increase it if I were to start over again. We have a capital of $200,000, of which $83,000 in stock has been sold and bonds in the sum of $83,000 have been issued. Our stockholders are all local men and are among the leading business men of the city.

"I believe our system is a little more expensive than coal, but I will say, frankly, that I do not believe you could go to the average consumer and get him

to change even though we increased our rate 25%.

"We dictate the amount of radiation for every home before it is installed, and will not take customers unless we are allowed to make the estimate. We do not, however, do any of the inside work ourselves.

"In all, I think we have about 200 customers."

Kiln-Dried Americans is the appellation given by a writer in the Milwaukee (Wis.) *Wisconsin* to the average house-dweller in America who provides no means for properly humidifying the air after it passes through the heating system. He quotes from a recent address by Dr. Paul W. Goldsbury, who states that "if the air outside should be carrying half a grain of water per cubic foot, which is perhaps a normal condition, and should be quickly heated and passed into the room, as is usually the case, it would be then in a condition when its appetite for moisture is increased eight times, and what it brought in from the street would be only one-eighth of what it ought to have to be relatively comfortable and healthful. It is true that the furnaces are usually provided with a water tank, but this is placed to suit convenience in filling it, and is in the colder part of the air chamber of the furnace, so that the air hurrying past has not either the time or the proper conditions to enable it to gather much as it passes, and is delivered into the rooms with little more moisture per cubic foot than it had out of doors. On the other hand, the indoor air, with its increased temperature, to be most comfortable and healthful, should carry about six grains per cubic foot.

"When these conditions are known one can begin to realize how much under-moistened the living rooms of houses are in winter. In official measurements of schoolrooms and hospitals, places for which provision is customarily made for proper air, the humidity has often been measured at below 3½ grains per cubic foot and occasionally below 1 grain."

Megaphones for use on street cars in announcing the street corners are being advocated in Chicago as a means of keeping the cars at the required temperature, through a less frequent opening of the doors.

Chicago, Ill.—A sub-committee of the council committee on city hall and public buildings has begun an investigation of the $107,000 heating and ventilating system in the city hall as a result of complaints of violent drafts and other alleged defects of the system.

United States Bureau of Mines, Washington, D. C., announces, through a bulletin on "The Physical and Chemical Properties of the Petroleum of the San Joaquin Valley, California," by Irving C. Allen and W. A. Jacobs, that, inasmuch as the art of burning heavy oils under boilers for steam raising has not been developed to its highest efficiency, the bureau will shortly undertake a thorough study of this problem.

A. Beaurienne, secretary of the Association des Ingénieurs de Chauffage and de Ventilation de France, will shortly visit the United States with the purpose of interesting the trade in a number of heating specialties designed by him. M. Beaurienne is the author of a number of papers on heating subjects, and recently contributed a paper on "Central Station Heating" to the National District Heating Association.

Manufacturers' Notes

American District Steam Co., North Tonawanda, N. Y., recently entertained a party of nearly 100 business men who had been invited to inspect the company's new plant and offices. The company recently completed its large new factory at North Tonawanda and moved its Lockport plant and office to the Lumber City. Many city officials of the Tonawandas were in the inspection party.

Canadian Sirocco Co., Ltd., Windsor, Ont., is the name of a Canadian factory

which has been established for the manufacture of the products made by the American Blower Co., Detroit, Mich. The company has acquired a tract of land comprising 4½ acres, and will proceed at once with the erection of a plant which, when completed, it is stated, will be one of the most complete of its kind in the country. The company will hold the exclusive patent rights for the manufacture in Canada of the Sirocco fans and blowers.

Gurney Heater Mfg. Co.'s new plant, South Framingham, Mass., is practically completed as to the buildings, and the company anticipates having the factory in entire running order early next year.

Consolidated Engineering Co., Chicago, is building a factory and office building at Michigan terrace and 40th street, Chicago, Ill. It will be a two-story fireproof building, 85 x 135 ft., and will be completed about March 1, 1912.

American Radiator Co., Chicago, announces that the old A. A. Griffing Iron Works, Jersey City, N. J., was sold at public auction, November 22, to Mr. Kenney, of Plainfield, N. J. The property contains more than seven acres of ground, and is improved with a number of one and two-story brick and frame buildings, including the factory, storehouses, offices, etc., and also has about 4000 ft. of railroad track on the premises.

Crane Company, Chicago, is having plans drawn for a five-story steel and concrete building to be erected at Ninth and Webster streets, Oakland, Cal., at a cost of about $150,000.

New Incorporations

Hart Heating Co., Chicago, Ill., capital $30,000.

Commonwealth Heating and Contracting Co., Richmond, Va., capital $10,000. Incorporators: Jay W. Start, Chas. F. Campbell, Harry C. Glenn.

Shields Steam Specialty Co., Louisville, Ky., capital $10,000, to manufacture steam specialties. Incorporators: George W. Shields, A. J. Breedlove, T. Q. Munce.

Evans Fitting Co., Camden, N. J., capital $50,000, to manufacture steel fittings for hydraulic and steam piping. Incorporators: F. R. Hansell, J. A. MacPeak, I. C. Clow.

Northwestern Plumbing Co., Missoula, Mont., capital $10,000. Incorporators and directors: V. L. Bullis, R. H. Dunlap, O. B. S. Orr.

James F. Blackshaw Plumbing Co., Jersey City, N. J., capital $10,000. Incorporators: Jas. F. Blackshaw, Ann Blackshaw, Stephen J. Connelly.

Mizell Hardware Co., Heavener, Okla., capital $6,000.

Ouray Hardware Co., Ouray, Colo., capital $20,000.

Ventilating Systems Co., New York City, capital $100,000. Incorporators: E. M. Hall, J. C. Geisler, T. C. Hall.

Joseph H. Pryor Co., Brooklyn, N. Y., capital $100,000. Incorporators: Joseph H. Pryor, J. J. Harlin, A. J. Pearson.

Sterling Brass Co., Cleveland, Ohio, capital $35,000. Incorporators: Alfred A. Benesch, Reuben Shapiro, Henry A. Rocker, E. M. Chalanpka, S. J. Kornhauser.

United States Steel Tank and Pipe Co., Chicago, Ill., capital $10,000. Incorporators: Henry N. Miller, S. M. Schall, A. C. Meyer.

New Firms and Business Changes

H. F. Luquire Plumbing and Heating Co., Macon, Ga., is the new name of the Alexander and Luquire Plumbing and Heating Co.

A. C. Eynon Plumbing Co., Canton, O., is erecting a large brick building at Walnut and Fourth streets, which it will occupy early in the year.

W. H. Schott Company, central station engineers, Chicago, Ill., announces the removal of its general offices from the Steger building, to suite 1813-1816 The Harris Trust building, 111 West Monroe street, Chicago.

H. W. Johns-Manville Company, New York, announces the removal of its Birmingham, Ala., office from 1220 Empire building to 606 Chamber of Commerce building, the new quarters being better adapted for their growing requirements. W. H. Fleming, well known throughout this section, will continue as manager. A complete line of asbestos and magnesia products will be handled from this office.

McGinness Company, engineers and contractors, Pittsburg, Pa., announces that it has taken over the steam heating and ventilating contracts of the American Warming and Ventilating Company, together with the working force, engineers, tools and equipment of this department. Under the name of The McGinness Company the old force and management will complete the unfinished contracts, and continue in the steam heating and ventilating business.

C. A. Dunham Company, Marshalltown, Ia., announces that it has brought suit against Warren Webster & Co., Camden, N. J., in the United States Federal Courts alleging infringement of their patents.

Business Troubles

Ætna Heating and Ventilating Co., New York City, has filed schedules in bankruptcy showing liabilities $17,019 and assets unknown. Among the creditors are: J. L. Mott Iron Works, $4,417; Arthur H. Kohn, $3,600, and New Britain National Bank, $2,000.

Contracts Awarded

Mueller Heating Co., Milwaukee, Wis., heating new south wing of capitol and southeast and southwest pavilions, at Madison, Wis., for $38,472.

Thomas E. Gildea, Syracuse, N. Y., heating new Sumner School at that place, for $2,352.

Malone & O'Rourke, Utica, N. Y., heating Presbyterian gymnasium and parish house, at that place.

MacKinnon Boiler and Machine Co., Bay City, Mich., was the only bidder for heating city hall, at $2,000 per year; the bid was referred to a committee to ascertain what was charged for similar services in other cities.

Johnstown Supply Co., Johnstown, Pa., heating and plumbing new Eagles' home, in Johnstown.

A. Holtman Heating Co., Kansas City, Mo., heating Missouri Pythian Home, Springfield, Ill., for $3,842.

Schweers Hardware Co., Green Bay, Wis., heating new county asylum, for $11,078.

Edmonds & Lovett, Kansas City, Mo., heating and ventilating addition to Yeager school for $2,578.

Walker & Chambers, New York City, heating new Mason Memorial Library building, Great Barrington, Mass.

Lynn, Mass.—The low bid for heating, ventilating and plumbing the new Eastern District grammar school was that of M. A. Dame Son Co., for $11,921. Other bids were: Huey Bros. & Co., Boston, Mass., $12,787; John F. Morgan & Son, $12,885; Nichols Drown & Co., $14,142; Sawyer & Hall, $14,505.

Mangrum & Otter, San Francisco, Cal., heating Gartland building, for $12,730.

M. D. Michael, Durant, Okla., heating new court house at Coalgate, Okla., for $17,500.

Rommel & Mueller Co., San Francisco, Cal., heating and plumbing new Alhambra school building, for $2,075.

Idaho Plumbing and Hardware Co., Boise, Idaho, heating and plumbing Government Reclamation Service building, for $2,999.

American Warming and Ventilating Co., Elmira, N. Y., heating and ventilating new Randolph (Vt.) schoolhouse, for $5,296.

M. J. Daly & Sons, Inc., Waterbury, Conn., heating, ventilating and plumbing two new factory buildings for Shoe Hardware Co.

New Haven, Conn.—Yale University's proposition to erect the new central heating plant, recently authorized, at Sachem street and Winchester avenue, is meeting with strong opposition on the part of the residents of that vicinity, who claim that the high chimney and the plant generally will result in a depreciation of property values.

McCusker Company, Portland, Ore., heating new wing of the Multnomah County Court House, for $70,727.

Robert Dalziell, Jr., Co., Oakland, Cal., heating, plumbing and galvanized iron work for the new Pantages Theater building; also heating and plumbing new four-story office building at Battery and Market streets, San Diego, Cal.

Cleghorn Company, Boston, Mass., heating and ventilating ten-story office building at Devonshire street and Spring Lane, Boston.

John H. Stevens, Manchester, N. H.,

heating and plumbing convenience station in Merrimack Common, for $4,111.

Albert B. Franklin, Boston, Mass., heating and ventilating new Carnegie Library building, Brockton, Mass., for $4,400.

Freeland Supply Co., Hazelton, Pa., heating plant for Grand Opera House.

F. S. Spencer, Minneapolis, Minn., heating and ventilating Barnum (Minn.) high school.

M. F. Rourke & Co., Knoxville, Tenn., heating court house, for $5,378.

F. S. Schardein & Sons, Louisville, Ky., vacuum steam heating and plumbing Galt House, for $15,000.

Richard Sherwood, Billings, Mont., heating new building at the county farm.

John P. Rickards, Olney, Pa., heating Masonic Temple, Georgetown, Del.

Virginia Heating and Plumbing Co., Virginia, Minn., laying heating mains at Eveleth, Minn., for $19,600.

Business Chances

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following named work:

Until December 14, 1911, for the reconstruction of the U. S. Marine Hospital, Stapleton, Staten Island, N. Y., consisting of two three-story wings, reconstructing the entire interior of the old building and adding a fourth story to a portion thereof.

Until December 20, 1911, for the construction of the United States Postoffice, Westfield, Mass., consisting of a one-story and basement building, having a ground area of 4,350 sq. ft.

Until December 27, 1911, for the construction of the Postoffice, Court House and Custom House at Miami, Fla., consisting of a three-story and basement building, ground area of 7,200 sq. ft.

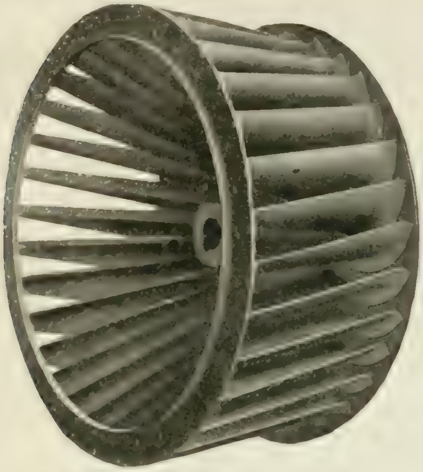
Until December 27, 1911, for the installation of a heating and ventilating apparatus, for the United States Postoffice and Custom House building at San Diego, Cal.

Until December 28, 1911, for the construction of the extension and remodeling of the United States Custom House, Boston, Mass.

Trade Literature

Buffalo Conoidal Blowers and Exhausters, so-called from the recurrence of conical shapes in their design, are featured in a new and comprehensive catalogue published by the manufacturers, the Buffalo Forge Co., Buffalo, N. Y. These are the company's new high-efficiency fans designed for large volumes and low pressures. The inlet is conical,

the blast wheel forms the frustrum of a cone and the blades are curved over the tapering surface of a cone. The manufacturers state that the advantage of this form of construction is that without preventing the maximum amount of air to



SINGLE "CONOIDAL" FAN WHEEL.

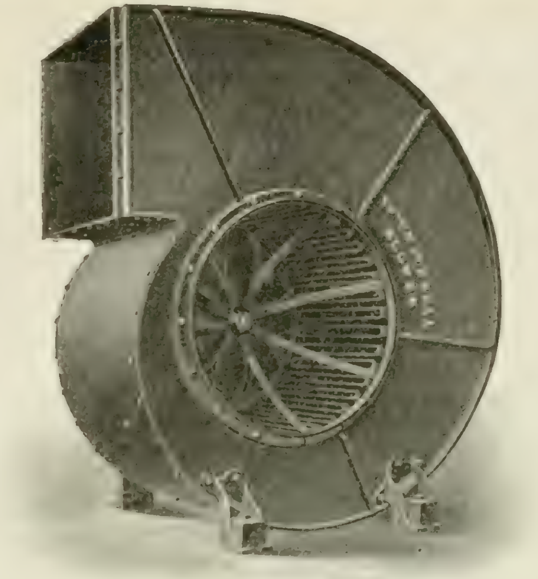
be taken up in front, a uniform supply is secured at every point of the blade from front to back and the air is delivered at a pressure which comes close to uniformity over the entire width of the outlet. This form of construction prevents the air from being drawn in at right-angles to the back or drive side and then being deflected at an angle of nearly 90° towards the blades and outlet, thus losing power and velocity. Another advantage mentioned for the Conoidal fan is the practically constant efficiency curve which permits operation at from 20% to 30% above and below the rated capacity, giving a total range of from 40% to 60%, with only a slight decrease in efficiency. A section of the catalogue is devoted to data, including curves, on the performance of the Conoidal fans of various sizes, with different diverging nozzles. The various parts of the fan are illustrated in detail and there are also a number of views showing typical installations. Shop drawings are included, with detailed dimension tables for all sizes of fans, from 30 in. to 200 in., single and double width, and for various discharges. Size, 6 x 9 in. (standard). Pp. 48.

Ideal Heating Journal for November, 1911, the new periodical of the American Radiator Co., Chicago, contains an interesting article on "Thermal Tests of Heating Boilers," with an illustration, from a photograph, of the boiler-testing room at the company's Institute of Thermal Research, in Buffalo. This room is

25 x 62 x 17 ft. high. There are 12 chimneys, each about 35 ft. high, with facilities for higher extensions when necessary, and varying from 8 to 24 in. in diameter. The photograph shows the tanks for measuring water evaporated in steam boilers, also a set of draft gauges for measuring frictional resistance in the fuel and flues. The article gives details of the company's method of testing boilers, and it is further stated that when a new design of boiler is being tested, glass plate windows are inserted in the boiler at convenient points. An electric light shows every movement of the water when the boiler is steaming. This device has been found to be an invaluable aid in making new designs. As the result of its tests, the company states that, in many cases, the catalogue ratings of its boilers have been shown to be but little more than half the maximum capacity of the boiler. Another article describes the United States Navy tests of Sylphon regitherms, used, in this instance, to control the temperature of the air in the powder magazines of battleships. Many other items serve to make the November number a notable issue.

J-M Packing Expert for November, 1911, published by the Cleveland branch of the H. W. Johns-Manville Co., contains an interesting item referring to the insulation installed in the Cleveland [illegible] Federal building. The heavy boiler-iron smokestack, which runs up through the center of the building, was covered with 6 in. of J-M asbestos fire-felt sheets, with J-M roll fire-felt on the outside. Notwithstanding the difficulties of the work, it was successfully accomplished. All of the pipe covering was also furnished by the H. W. Johns-Manville Co.

Economical Steam Power Plants, a 24-page pamphlet published by the Green Fuel Economizer Co., Matteawan, N. Y., describes four of the largest modern steam power plants in the world, including the Hudson and Manhattan power station in Hoboken and the plant of the Laclede Power Co., St. Louis, Mo. The pamphlet also contains a fifth paper on economizer practice, discussing the theory of the lowest economical difference in temperature between the gases entering the chimney and the cold boiler feed water. It is shown that, whereas there is little economy in reducing the temperature of chimney-flue gases lower than 500° to 550° F. by means of boiler surface, the temperature of the same gases may be reduced to 200° F. or 250° F. quite profitably by means of economizer surface, because of the lower temperature of the contents of the economizer and the less costly nature of the economizer surface.



INTAKE SIDE—80″ DIRECT-CONNECTED BLOWER

Isometric Drawing Paper, on which a drawing may be scaled in the three main directions, the axes of which are 120° apart, one being vertical, the others being at 30° from the horizontal, has been placed on the market by the Norman W. Henley Publishing Co., 132 Nassau street, New York. It is furnished in pads of 40 sheets, 6 x 9 in., at 25 cents; or, 9 x 12 in., at 50 cents. The paper also comes in loose sheets, 12 x 18 in., at $1.00 for 40 sheets. By the use of this paper, any special knowledge of isometric projection is unnecessary, as it is easy to complete such drawings with but little calculation. All horizontal lines are laid along the 30° line in either direction. Thus a cube becomes a hexagon and circles ellipses. The advantage of this arrangement lies in the fact that one is enabled to make a scaled sketch, showing an article in its entirety, so that it is not necessary to study the details of an ordinary three-view drawing.

TRADE AND MISCELLANEOUS NOTES

Coming Events

American Society of Inspectors of Plumbing and Sanitary Engineers, Milwaukee, Wis., Feb. 6-8, 1911.

National Association of Master Plumbers, Galveston, Texas, June, 1911. Headquarters at the Hotel Galvez.

Deaths

Matthew Kennedy, treasurer of the Kennedy Valve Mfg. Co., Elmira, N. Y., died Nov. 26, at his home in that city.

R. Barnard Talcott, heating and ventilating engineer in the office of the Chief Mechanical and Electrical Engineer of the Treasury Department, Washington, D. C., died in Lutherville, Md., Dec. 4. He was 78 years old and was a member of the American Society of Heating and Ventilating Engineers.

Ira Budd, a well-known heating and plumbing contractor of Newark, N. J., died Dec. 14 at his home in Newark after a prolonged illness. He was 59 years old and had been connected with the plumbing and heating trade throughout his business career. He was prominent in trade association circles, having been successively secretary, vice-president and for three years president of the Newark Master Plumbers' Association. He was also the first president of the New Jersey State Master Plumbers' Association and served for many years as state vice-president for New Jersey of the plumbers' national association.

Edward G. Herendeen, formerly president of the Herendeen Mfg. Co., Geneva, N. Y., which was merged some time ago with the United States Radiator Corporation, died at Pinehurst, N. C., from heart failure December 20. He was 52 years old. Mr. Herendeen, at the time of his death, was senior partner in the law firm of Herendeen & Mandeville, Elmira, N. Y.

Manufacturers' Notes

New York Radiator Co., Frankfort, N. Y., has increased its capital stock to $100,000.

E. F. Reece Co., manufacturer of taps and dies, and F. E. Wells & Son, manufacturers of pipe threading tools and machinery, both of Greenfield, Mass., have merged their interests. The new firm will occupy the quarters of the Wells company which will be enlarged.

H. Mueller Mfg. Co., Decatur, Ill., has increased the capacity of its plant by the addition of a two-story building, 50 x 100 ft. The building will contain two new 200 H P boilers and a new [illegible] H P engine. This equipment gives the company's plant a total horsepower of about 1,200.

O'Reilly & Blatt, Reading, Pa., successors to the Prizer-Painter Stove & Heater Co., announce that they are prepared to furnish castings for the line of stoves and hot air furnaces formerly made by the Prizer-Painter Co., also for the Henderson Thermo boilers.

H. B. Smith Co., Westfield, Mass., is adding several new buildings to its South Side plant, including a machine shop, 100 ft. x 100 ft. and two stories high; a 100 x 245 ft. foundry building, connecting with the present foundry; a steel frame building to replace the present wooden storehouse; and a concrete core building 80 x 100 ft. and two stories high.

John Simmons Co., New York, the well-known heating and plumbing supply house, has arranged an extensive display of plumbing goods at its new plumbing goods show room, 48 East 41st street, in charge of C. W. Frean. The warehousing facilities of the Bush Terminals in Brooklyn are utilized, direct communication to them being had through the telautograph system.

Michigan Pipe Company, Bay City, Mich., reports a recent instance of its steam pipe casings having successfully withstood a wear of 30 years. In one instance of a special test a line of wood casings were taken up after a use of 10 years and the covering found to be in perfect condition. The company states that wood casing with the tin lining and air space between the wrought iron pipe and inner surface of the wood is used by the largest central heating plants in the country and is claimed to be the best prevention of condensation and heat loss on the market.

B. F. Sturtevant Co., Hyde Park, Mass., reports, among its recent orders, the ventilating apparatus for the Ritz-Carlton Hotel, New York; forced draft

equipment for the New York Central power house, New York; apparatus for the South Orange (N. J.) school and the apparatus for the Manual Training High School in Newark, N. J.

Pierce, Butler & Pierce Mfg. Co., Syracuse, N. Y., reports the following recent installations of its boilers in New York and vicinity:

Home of the Daughters of Jacob.
Beth El Sisterhood.
Nichthauser & Levey, Brooklyn.
Brunswick Realty Co., 118 East 28th St.
Pollard & Steinam (sanitarium).
Brody, Adler & Koch, 8-10 West 19th St.
Club House, at 48-50 Henry St.
Schaeffer & Carroll (synagogue).
Apartment Const. Co., 810 Broadway.
Pollard & Steinam, 394 Fifth Ave.
Whiteney Steen Co. (Golden-Hill Bldg.).
Master Builders Assn., 8-14 East 12th St.
Edgar Lehman (residence West 79th St. and Riverside Drive).
Pollard & Steinam Apt. Hotel, 12th St. and Fifth Ave.
Maas & Blum, 124th St. and First Ave.
R. M. Silverman Realty Co., 17-19 West 17th St.
F. C. Zobel, 32-34 West 20th St.
Fischel Realty Co., 48-50 West 21st St.
Brody, Adler & Koch, 40-42 East 19th St.
Gobel Residence, Brooklyn.
Harris & Seigel, 121st and Lenox Ave.
Isaac Polstein, West 99th St.
McKinley Realty Co. (McKinley Bldg.).
Goodyear Rubber Co., 64th and Broadway.
Roosevelt Court, 69th St. and Amsterdam Ave.
Lebanon Hospital Training School.
Jones Speedometer Co., 76th St. and Broadway.

Miscellaneous Notes

Midland Club, at its annual meeting, December 13 at the LaSalle Hotel, Chicago, re-elected the following officers for the ensuing year: President, A. W. Williamson; vice-president, L. J. Mueller, Jr.; secretary, Allen W. Williams. A paper was presented by R. L. Spellerberg, Dubuque, Iowa, on the use of large pipes in furnace heating.

Columbus, O.—A plan to heat the new cell blocks at the penitentiary by steam at a cost of $18,000 was adopted by the board of penitentiary managers, early in December.

Baltimore, Md.—The property and assets of the Baltimore Refrigerating and Heating Co., which have been in litigation for several years, will be sold at public auction under the decision of Judge Stockbridge in Circuit Court No. 2. The Continental Trust Co., holder of a mortgage on the property, has been named as trustee to make the sale. The purchaser will be required to deposit $25,000 when the property is sold. The property is said to be worth nearly $2,000,000 and has been in the hands of the receivers for more than two years.

Philadelphia, Pa.—The first account of the estate of William Sellers, formerly president of the William Sellers Co., tool and machinery manufacturers, who died in 1905, was filed by the executors December 8 and shows the estate to include property valued at $5,622,238.18.

Detroit, Mich.—Indictments against 16 firms and 32 individuals alleged to have secured control of over 85% of the annual output of enameled iron bath-tubs, sinks, lavatories, etc., in the United States, which were returned by the Federal grand jury December 6, are against the following firms:

Standard Sanitary Mfg. Co., Pittsburg, Pa.; L. Wolff Mfg. Co., Chicago, Ill.; A. Weiskittel & Sons Co., Baltimore, Md.; The Barnes Mfg. Co., Mansfield, O.; The Cahill Iron Works, Chattanooga, Tenn.; Colwell Lead Co., New York City; The Day-Ward Co., Warren, O.; The Humphryes Mfg. Co., Mansfield, O.; Kerner Mfg. Co., Pittsburg, Pa.; The J. L. Mott Iron Works, New York City; McVay & Walker, Braddock, Pa.; The McCrum-Howell Co., New York City; National Sanitary Mfg. Co., Salem, O.; Union Sanitary Mfg. Co., Noblesville, Ind.; Wheeling Enameled Iron Co., Wheeling, W. Va.; United States Sanitary Mfg. Co., Pittsburg, Pa.

In addition to the charge of combining to restrain trade by refusing to sell to jobbers handling the goods of so-called independents, the indictments mention the practice of fixing resale prices and the combination's refusal to sell to jobbers not maintaining such resale prices.

Chicago, Ill.—The annual meeting of the Supreme Fold of the United Bunch of Sheep of America, which was announced to have been held December 17, was postponed until the first Friday in March.

Montpelier, Vt.—A committee of the House of Representatives has been named to investigate the $35,000 ventilating system recently installed in the Capitol, which is not proving satisfactory.

National Association of Brass Manufacturers, at its annual meeting in New York, December 13-14, elected the following officers for the ensuing year:

President, Theodore Ahrens, Louisville, Ky.; trustees: A. S. Hills, Haydenville, Mass.; W. H. Wasweyler, Milwaukee, Wis.; C. C. Hale, New Haven, Conn.; D. H. Roberts, Detroit, Mich.; F. Somerville, Toronto, Canada; J. W. Sharpe, Jr., Philadelphia, Pa. The next meeting will be held in Chicago in March, 1911. Wm. M. Webster, 109 Randolph street, Chicago, was reappointed commissioner.

Dresden, Germany.—A congress of heating and ventilating engineers will be held in Dresden, June 11-14, 1911. The meeting will thus coincide with that of the International Hygiene Exposition in Dresden.

Charles G. Armstrong & Son, consulting engineers, Singer Building, New York, is a new firm composed of Charles G. Armstrong, the well-known mechanical and electrical engineer, and his son,

Francis J. Armstrong, who is a graduate of the Manual Training School in Chicago and of the Stevens Institute of Technology.

George D. Howell, of the McCrum-Howell Co., New York, has returned from a trip to the Panama Canal and other points in Central America. He was at the canal during the visit of President Taft and, on invitation of Col. Goethals, traveled with the presidential party by rail to Ancon, the Pacific terminus.

O. E. Willis, formerly with the American Heating and Ventilating Co., Philadelphia, has entered the engineering department of E. G. Woolfolk & Co., heating and ventilating engineers and contractors, 151-153 West 31st street, New York.

W. H. James, who has been in the service of the Peck-Williamson Co., Cincinnati, O., for the past ten years, acting as salesman, has resigned. Mr. James will introduce to the manufacturers of heating apparatuses his recently patented down-draft method of burning fuel. The method, it is stated, may be applied to any kind of fuel-burning apparatus.

Cement Age, of New York, and *Concrete Engineering* of Cleveland, two of

the leading monthlies in the cement field, have been consolidated, the change becoming effective with the January, 1911, issue. The two journals are consolidated under the title of "Cement Age with which is combined Concrete Engineering."

Contracts Awarded

E. O. Nay Co., Pasadena, Cal., heating and plumbing new Y. M. C. A. building at that place for $18,000

Baker, Smith & Co., New York, have been awarded the contract for the installation of the heating and ventilating system in the new post-office building in New York. Their bid was $165,546, time 230 days. Among the other bids received by the Supervising Architect were the following:

G. A. Suter, New York, $185,700; time, November 1, 1912.

Thompson-Starrett Co., New York, $185,770; time, October 15, 1912.

E. Rutzler Co., New York, $182,741; time, November 1, 1912.

Blake & Williams, New York, $189,878; time, 18 months.

Lynch & Woodward, Boston, Mass., $170,770; time, October 1, 1912.

S. Faith & Co., Philadelphia, Pa., $234,920; time as specified.

Evans, Almiral & Co., New York, $199,-450; time, 15 months.

Gillis & Geoghegan, New York, $195,-600; time, November 1, 1912.

Hoben & Doyle, Philadelphia, Pa., $190,000; time, December 1, 1911.

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BOOKS ON HEATING AND VENTILATION

Heating and Ventilating Buildings, a standard manual for heating engineers and architects. By Prof. R. C. Carpenter. Fifth edition, largely rewritten. 577 pages. 277 Ills., 8vo, cloth. $4.00

Baldwin on Heating; or Steam Heating for Buildings By William J. Baldwin. Fifteenth edition. Revised and enlarged. 391 pages. 131 figures. Size, 5x7½ in. Contains descriptions of steam heating apparatus for warming and ventilating large buildings and private houses, with remarks and tables. Cloth, $2.50.

Handbook for Heating and Ventilating Engineers. By Prof. James D. Hoffman and Benjamin F. Raber. The latest book on this subject. Unusually comprehensive. [illegible] pages with 45-page appendix. Size 4½x6¼ in., bound in flexible leather. Price, $3.50.

Questions and Answers on the Practice and Theory of Steam and Hot-Water Heating. By R. M. Starbuck. Illustrated. $1.00.

The Ventilation of the Schoolroom. By William J. Baldwin. Price, $1.00.

Ventilation of Buildings. By William G. Snow and Thomas Nolan. 83 pages. Pocket size. Contains a statement of the general principles of ventilation and of their application to different kinds of buildings. Boards, 50c.

Steam Heating and Ventilation. By Wm. S. Monroe. Containing formulas and data valuable in the designing of heating and ventilating plants. Price, $2.00

Air-Conditioning. By G. B. Wilson. Being a short treatise on the humidification, ventilation, cooling and the hygiene of textile factories—especially with relation to those in the U. S. A. With figures. 12mo. Illustrated. 143 pages. Price, $1.20.

Steam-Electric Power Plants. By Frank Koester. A practical treatise on the design of Central Light and Power Stations and their economical construction and operation. 473 pages. 340 ills. Price, $5.00.

Light, Heat and Power in Buildings. By Alton D Adams, M. E. The purpose of this volume is to present in compact form the main facts on which selection of the sources of light, heat and power in buildings should be based. The problem is to determine the kind of equipment that will yield the service required at the least cost. 12mo. Cloth, $1.00.

Practical Steam and Hot Water Heating. By Alfred G. King. Containing over 300 detailed illustrations. The book is a working manual for heating contractors, journeymen steam fitters, architects and builders. Describes various systems of heating and ventilation and includes useful data and tables for estimating, installing and testing such systems. 8vo. 367 pages. Price, $3.00.

Dean's System of Greenhouse Heating, by steam or hot water, with formulas for obtaining different temperatures, by Mark Dean. Price, $2.00.

Power, Heating and Ventilation. By Charles L Hubbard, B.S., M.E. A treatise for designing and constructing engineers and architects. The whole subject of heating is covered, including the heating of large institutions with central plants. Space is also devoted to electrical matters connected with steam plants. 647 pages. Price, $5.00 (three volumes in one).

Notes on Heating and Ventilation. By John R Allen. 152 pages. 34 illustrations. Size, 4½x6½ in. One of the new books, brought quite up to date, and containing much information to guide the intelligent steam fitter in the installation and heating and ventilating apparatus. Cloth, $2.00.

Hot-Water Heating and Fitting. By W. J. Baldwin Fourth edition. Price, $4.00.

Steam Fitters' Computation and Price Book, abridged. By Mark Dean. Price, $2.50.

Practical Treatise Upon Steam Heating. By F. Dye. Embracing methods and appliances for warming buildings, etc. Low pressure, high pressure and exhaust steam. 8vo, cloth, illustrated. Price, $4.00.

The School House. Its Heating and Ventilation. By J. A. Moore. 204 pages, illustrated. $2.00.

A Manual of Heating and Ventilation, for engineers and architects, embracing tables and formulas for dimensions of pipes for steam and hot-water boilers, flues, etc. By F. Schumann. Second edition, revised and enlarged. 12mo, $1.50.

German Formulas and Tables for Heating and Ventilating Work, especially adapted for those who plan or erect heating apparatus. By Prof. J. H. Kinealy. Illustrated. Price, $1.00.

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Centrifugal Fans. By J. H. Kinealy. A theoretical and practical treatise on fans for moving air in large quantities at comparatively low pressures. 206 pages. 39 diagrams. Full limp leather pocketbook round corners, gilt edges. Price, $5.00.

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An Outline of Warming and Ventilating. By William J. Baldwin. Price, $1.00.

Modern Sanitary Plumbing, Steam and Hot Water. By James J. Lawler. 400 pages. 228 illustrations. Size, 6x9 in. This is the latest edition of Mr. Lawler's well-known work on this subject. Price, $5.00.

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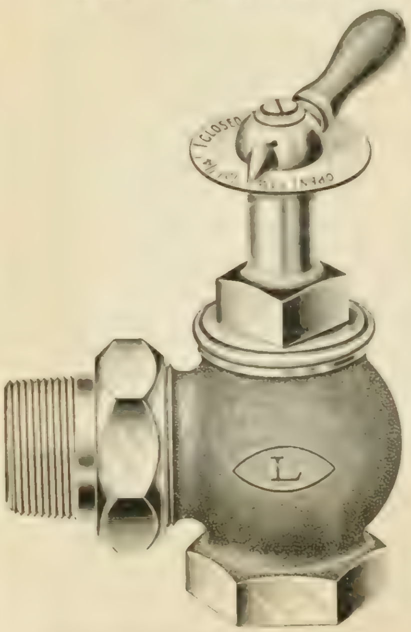

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